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JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

ALBION REED HODGDON, Editor-in-Chief

ALBERT FREDERICK HILL
STUART KIMBALL HARRIS
RALPH CARLETON BEAN
ROBERT CRICHTON FOSTER
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LORIN IVES NEVLING, JR.
} Associate Editors

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A MULTIVARIATE ANALYSIS OF THE PINUS CHIAPENSIS-MONTICOLA-STROBUS PHYLAD[1]

JOHN W. ANDRESEN

As considered here, *Pinus chiapensis* (= *Pinus strobus* var. *chiapensis* Martinez) is the southern member of the North American pine phylad *Pinus chiapensis-monticola-strobus*. Phytogeographically, this complex forms a broad discontinuous triangle with apices of species distribution in British Columbia, Newfoundland, and Guatemala (Fig. 1).

Earlier, the taxonomic recognition of *Pinus strobus* var. *chiapensis* Martinez was questioned by several authors (Braun 1950: 483; Martin and Harrell 1957; Sharp 1946) who regarded it as a weakly-differentiated geographic form of *P. strobus* L. undeserving separate taxonomic rank, but others (Loock 1950: 117-119; Soto, Barrett, and Little 1962: 52-53; Standley and Steyermark 1958: 55-56) agreed with its varietal status. Gaussen (1960: 91, 198) proposed it as a distinct species but his new combination was not validly published because he omitted citation of the basionym (Art. 33, I.C.B.N., Lanjouw, *et al.* 1961).

These divergent opinions prompted the present biometric study to provide a statistical basis for a determination of the proper taxonomic disposition of this controversial taxon. In a companion paper (Andresen 1964), it is recommended that *P. strobus* var. *chiapensis* be elevated from varietal to

[1]This study was supported in part by funds from National Science Foundation Grant No. G-15879.

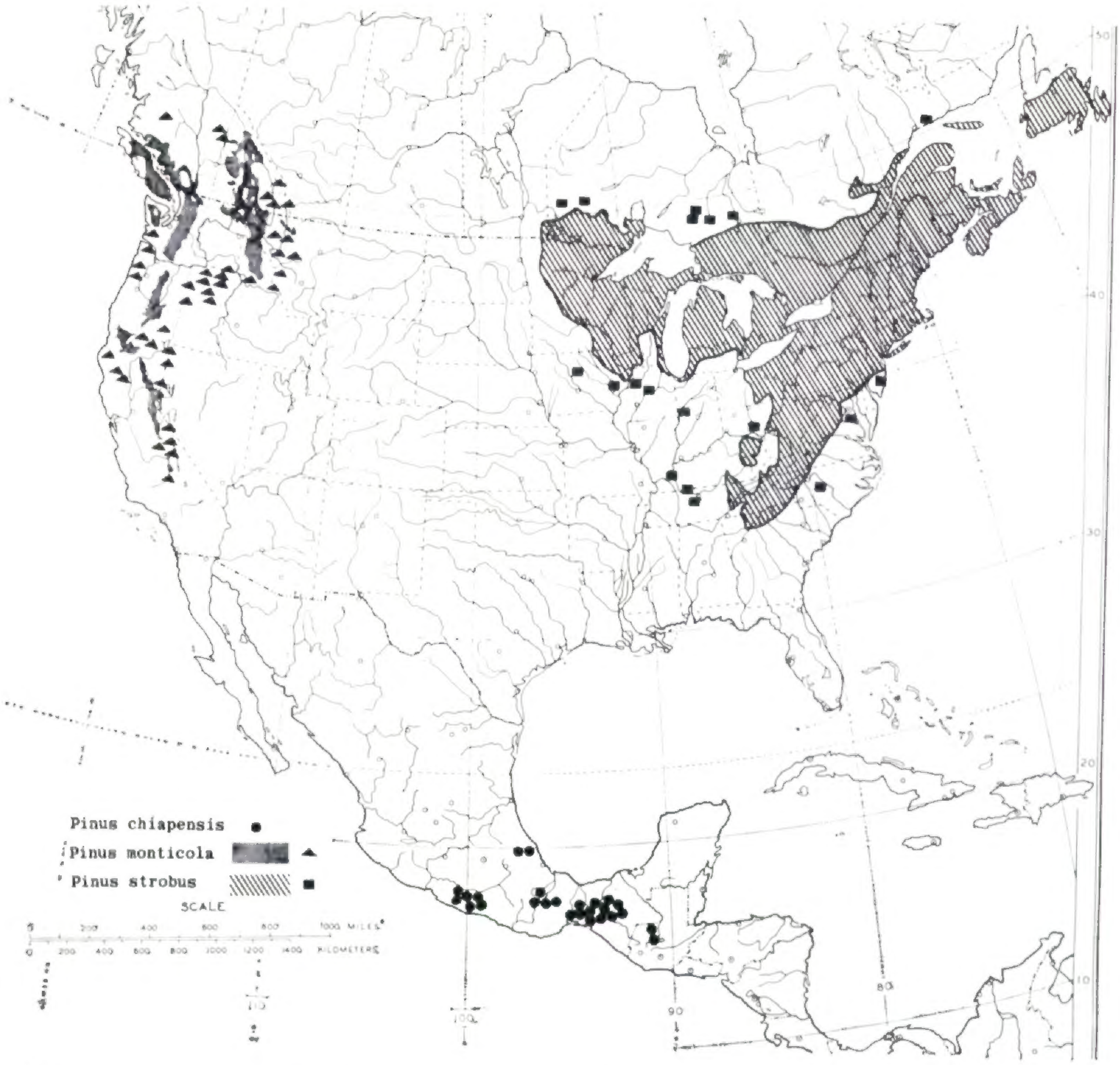

Fig. 1. — Distribution of the phylad *Pinus chiapensis-monticola-strobus* in Central and North America. Adapted from unpublished map supplied by U. S. Forest Service. Plotted on Goode's Base Map No. 202 by permission of the University of Chicago Press.

specific rank with the binomial *Pinus chiapensis* (Martinez) Andresen. The proposal was predicated on evidence obtained from the following study of morphologic and progeny data that were not available to previous authors. Following the analysis of this data, it became apparent that there was a much wider genetic and morphologic divergence than was previously suggested between *P. strobus* var. *chiapensis* and typical *P. strobus*.

Recent conceptual advances in the field of biosystematics (Heslop-Harrison 1963, Heywood and Love, 1963), that presented a clearer perspective of the problem at hand, led

Rogers (1963), and Sokal and Sneath (1963) to stress the value of reliable statistics that incorporate fundamental quantitative characters to determine taxa affinities or differentials. They coined the terms "taximetrics" and "numerical taxonomy" respectively, to focus attention on the statistical techniques designed to solve problems associated with experimental taxonomy. In this respect it is of primary importance to the taxonomist that contemporary statistical analyses and those yet to be derived can be programmed, especially with the aid of electronic computers, to assess the taxonomic value of any taxon trait or group of characters.

As an example, Davidson (1963) developed an "Itemized frequency distribution" and set of association indices based on the F statistic, to discriminate *Cirsium altissimum* from *C. discolor*. In a study of variability of the Pacific Coast and Rocky Mountain forms of *Pinus contorta*, Jeffers and Black (1963) used three forms of multivariate analyses which incorporated the "Q-technique," discriminant analysis, and component analysis, all of which rely on various manipulations of the correlation coefficient and its components. In this study, to show the degree of discrimination within the *Pinus chiapensis-P. monticola-P. strobus* complex, I employed the coefficient of divergence (*C.D.*) technique (Clark 1952) which is based on the sum of mean differentials of multivariate characters. To evaluate and assign relative importance values to the 12 leaf and cone characters used in the *C.D.* analysis, the F Statistic, intraclass correlation (expressed as a reliability index, R_I), and coefficient of variation were also used.

Data for the multivariate character analysis of cones, leaves, seed, and seedlings were obtained from herbarium and living specimens. Sample sizes, characters examined, statistical techniques, and pertinent examples to illustrate a particular method used are included as footnotes to data tables or in the discussion of the characters.

In the following text, P*inus chiapensis* is coded as *A; P. monticola* Dougl. as *B*; and *P. strobus* as *C*, except where the Latin binomials are more useful for clarity or emphasis.

COEFFICIENT OF DIVERGENCE VALUES

Before the importance of individual characters and their component roles in species delimitation within this phylad are evaluated, an explanation of the simultaneous treatment of fundamental characters is in order. A useful measure that incorporates this technique is the coefficient of divergence which is used in association with F statistics and reliability indices to summarize leaf and cone characters Q_1 to Q_{12} species pairs *AB, AC,* and *BC.* The method (Clark 1952, Klauber 1940) of arranging or ranking taxa in relation to the ascending magnitude of their *C.D.*'s is especially germane to studies utilizing objectively scored traits. Although Clark (1952) referred to herpetological data in his example, the extension of Klauber's (1940) one-dimensional coefficient by Clark is adaptable to any numerical or coded array of biologic parameters computed as a series of multiple character means.

In the present example (Table 1) four results are apparent: (1) About the same degree of information was provided by either 39 random samples or the total number of herbarium specimens examined (see Tables 1 and 2 to compare means of characters Q_1 to Q_{12} for the two sample sizes); (2) The *C.D.'s* derived from cone characters alone were greater in pairs *AB* and *AC*; (3) Leaf characters were more important than cone traits in computing the *C.D.* for *BC*; (4) With the incorporation of all 12 characters, *BC* is less than one-half as divergent as either *AB* or *AC.*

This magnitude of divergence, or lack of it, is of special significance — for according to the *C.D.* ranking, two long-recognized species, *P. monticola* and *P. strobus*, are much more closely aligned to one another than the species *P. strobus* is to its supposed variety *chiapensis.* This evidence, primarily the strength of the following F and R_I statistics

for the leaf and cone characteristics, plus other pertinent data, motivated the author to elevate *P. strobus* var. *chiapensis* to specific level (Andresen 1964).

LEAVES

Leaf length (Q_1) was greatest for *A*, but leaf width (Q_2) was least (Table 2). Thus, the resultant W/L value (Q_3) for *A* was smallest. Conversely, the shorter but wider leaves of *B* had a high W/L ratio that was twice as great as the value for *A*. An intermediate value of Q_3 for *C* is a reflection of the interjacent values of Q_1 and Q_2. The interpretation of this value, however, should be tempered by the lack of significance in the F statistic and the low reliability index of .497 for Q_2 in species pair *AC*; thus the component of greater relative importance for Q_3 in *C* is leaf length.

The role of leaf length in the ratio is emphasized because numerous authors (Loock 1950: 117; Martinez 1948: 133; Schwerdtfeger 1953; Sharp 1946; Soto, Vazquez, and Little 1962: 53) describe the leaves of *P. chiapensis* as "more delicate," "more slender," "finer," or "thinner" than *P. strobus*. These comparatives are misleading, however, when Q_1 and Q_2 are examined objectively. As shown earlier, there is a highly significant difference between *A* and *C* in regard to length but the width differential is non-significant. With these and other facts in mind, the following thoughts are offered to attempt an explanation of the reasoning of previous observers. In the field, the illusion of angustifoliation is probably created when observers familiar with leaf length in *P. strobus* subconsciously compare the much longer (and seemingly thinner) leaves of *P. chiapensis* and infer that the leaves of *A* are more delicate. But more important, because most descriptions are based on dry material, the gracile appearance of desiccated specimens is related to the herbarium artifact caused by severe dehydration and subsequent collapse of the leaf mesophyll. This condition was suggested when dried leaf specimens of *A* were noted to be deeply concave on all three surfaces (turgid leaves bear slightly convex surfaces), were curled

or twisted, and seemed lighter in weight than dried leaves of either *B* or *C*. To advance this postulation I (1) dried 125 leaves of *A*, *B*, *C*, and *B* X *C* grown under similar conditions near Placerville, California, and (2) calculated the proportionate weight loss of each set of samples by comparing fresh weight (weighed immediately after collection) to oven-dry weight. The differential percentages (Table 4) illustrate a much greater weight loss in *A* than the other three which were not significantly different from each other. Although tabulated at the 5% level of significance *A* was actually significant at the 2% level of confidence. The loss of 69% of the original weight in *A* is attributable mainly to the removal of fluids (mostly water) from the abundant intercellular space within the leaf mesophyll. A comparison of intercellular spaces within the leaves of the four taxa (Table 4) illustrates the significant differential between *A* and the other three.

Another feature which has previously been used to separate *A* from *C* is the supposed higher number of foliar resin canals in the former (Gaussen 1960: 91; Loock 1950: 117, Martinez 1940, 1947: 134; Soto, Vasquez and Little 1962: 53). This group of authors contends that the more common number of resin canals in *A* is 3 and more often 2 in *C*. The analysis (Table 4) however, provides data to the contrary. Based on 500 observations, *t* values at the 5% and 1% levels shows no significant differences between *A* and *C*. Mean values of 2.52 and 2.57 respectively, low standard deviations, and ranges of 2 to 3 resin canals for both species invalidate this character as a trait of differentiation. Although there is an overlap of range in number of resin canals between *B* and the former two, there is a significant difference between the means, so this feature could be used to separate *B* from *A* or *C*. Of interest is the broad range of numbers of resin canals in the hybrids of *B* and *C* and the large standard deviation, but this is an established pattern with numerous hybrid pines (Keng and Little 1961).

Even though the original description (Martinez 1940) of *A* was predicated on the criteria of thinner leaves and a greater number of foliar resin canals than *C*, the data indicate that both characters are of little or no value in separating the two taxa.

On the other hand, a character apparently overlooked in the past that has high diagnostic utility is the degree of leaf serration, Q_4 (Table 2). In fact, the F value for this character for species pairs *AB* or *AC* was the most significant of any leaf parameter. Twice as many serrations per 5 mm interval were found on *A* when compared to *C*. The high reliability index of .995 for Q_4 of pair *AC* also demonstrates the dependability and high level of confidence to be expected when using this trait for species separation. Also, a low coefficient of variability of 14.3 for *A* in contrast to 25.4 for *C* and 57.5 for *B* is added measure of reliability for this character in *A*. In a progeny study of juvenile forms of *P. strobus*, Mergen (1963) found an increase in serration number in relation to progression from southern to northern sources of origin. We found just the opposite trend in mature field specimens, and observed a random pattern in juvenile specimens.

The weakest leaf character of the five examined (Table 2) was the number of stomatal rows borne on the ventral (adaxial) surface, Q_5. Although there was a significant difference between *A* and *C* for Q_5, the reliability index was lowest in comparison to the other significant features of leaf characters. Stomata on the dorsal (abaxial) surface, although not included in the character analysis, were absent on all 440 leaves examined of *A* and all 3408 leaves examined of *C*. Dorsal stomata were present, however, on *B* leaves with a mean of 0.28 and a range of 0 to 4 based on a 1279 leaf-count. When present, this is a reliable character to separate *B* from *C* (Harlow 1947, Sargent 1897: 23, Shaw 1914: 34). In two studies of pine leaves however, (Doi and Morikawa 1929, Sutherland 1934) reported an absence of dorsal stomata in *B*.

Fig. 2. — Comparison of cone characteristics of *Pinus chiapensis* (*A*), *P. monticola* (*B*), and *P. strobus* (*C*).

PLATE 1318

CONES

Since the value of the mean for ovuliferous scale number (Q_6) was highly dissimilar between the three species and *C.V.*'s were relatively small, large F statistics and strong reliability indices were derived. The highest number of scales were found on *B* (Fig. 2, Table 2) and even though there were about 25% more scales per cone in *A* than in *C*, cone lengths were not significantly different. Precise cone-phyllotaxis of the three species was very difficult to determine in mature open cones, so this trait was ignored.

Shaw (1914: 12) observed that this pattern of cone scale arrangement presented an indefinite phyllotaxy for the sub-genera Diploxylon and Haploxylon and the only importance of phyllotactic differential is that it separates the two sub-genera on the basis of a higher order-fraction in the former group. Nevertheless he commented that in cones of equal size, *B* had an obviously higher phyllotaxy than *C*. The phyllotaxy of *A* was also higher than *C* but lower than *B*.

Apophysis width (Q_7) in both *A* and *C* was similar, but length (Q_8) was more divergent, (Table 2, Fig. 2). Even though Q_7 and Q_8 were dimensionally greater in *B* than in the other two taxa, the resultant ratio (Q_9) of the three species was largest for *A* because of its higher proportionate width. A high F statistic and reliability index of .959 of Q_9 for *AC* indicate the potential diagnostic value of this trait. In pair *BC*, the ratio differential was non-significant with a low R_1, and so was of little value in separating the cones of *B* and *C*.

Length of peduncle (Q_{10}) was greatest in *A*, but shorter and about the same for *B* or *C*. Although F and R_1 values of Q_{10} were high for pairs *AB* and *AC*, the low values in association with *BC* indicate the similarity of this trait in *B* and *C*. Character Q_{10} is, at times, difficult to measure for the peduncle is brittle and tends to fracture easily. Caution must be exercised to carefully collect and store the cones to avoid negation of this character.

Another reliable cone trait to isolate *A* from *B* or *C* is the degree of scale margin undulation (Q_{11}). In *A*, the apophysis margin with inflexed umbo-tip forms several involutions (Fig. 2) rarely found in *B* or *C*. As with peduncle length, scale margin bore differentially high statistics for pairs *AB* and *AC*, but was useless to segregate *B* from *C* in which the umbos were simply concave. Martinez (1940) and Soto, Barrett, and Little (1962: 53) described the umbo as having ". . . undulating edges turned inward." but in their work this conspicuous feature was not com-

Fig. 3. above — Basal scale configuration of *Pinus chiapensis* (*A*), *P. monticola* (*B*), and *P. strobus* (*C*).
Fig. 4. below — Ovuliferous scales (adaxial surface) of *Pinus chiapensis* (*A*), *P. monticola* (*B*), and *P. strobus* (*C*).

PLATE 1319

pared to other species. Also, the scale apex of *A* is truncate versus the rounded apices of *B* and *C* (Fig. 4).

The most outstanding difference in cone morphology and the character that was related to the highest F and R_I values of all leaf and cone characters for pairs *AB* and *AC* was the relative number of basal reflexed scales (Q_{12}). This curving of scales contiguous to the peduncle of taxa *A* and *B* is obvious in numerous illustrations (Gaussen 1960: 199; Harlow and Harrar 1958: 57; Sargent 1897: plates 539, 541; Sudworth 1908: Fig. 2). In Fig. 3,

a comparison of the number and presence of these scales in *B* and *C* is made with the lack of reflexing in *A*. In our samples of *A*, none of the cones bore basal scales that were fully reflexed, and only a few were weakly curled. Since F and R_1 values were high for all three pairs, an examination of Q_{12} alone would suffice to determine individual members of the phylad.

In addition to the foregoing values obtained from leaf and cone measurements, the data following the discussion of sample size also add confirming evidence that *P. chiapensis* is strongly divergent from *P. strobus*.

SIZE OF SAMPLE

In biometric analyses, achievement of the highest degree of precision commensurate with judicious use of time is a goal of primary importance. In Table 1, it is demonstrated that approximately the same coefficient of divergence can be calculated by measuring relatively large numbers of specimens or by a less time-consuming random sample of 39. The question then is how many samples are required to provide a desired level of accuracy in separating these taxa? Numerous models and examples are offered by Cochran and Cox (1950), Dixon and Masey (1957), and Snedecor (1956), but I prefer the technique derived by Wright and Freeland (1960). Their method, in which it is advantageous to use small sample numbers, employs standard deviations and means of the components of any species pair. When substituted in the formula in Table 3, these values multiplied by an appropriate "t" provide a predictable sample size for any required level of accuracy. Since the minimum number of complete samples within *A*, *B*, or *C* was 39 and a recommended minimum sample (Freese 1959) should approximate 30, we used a set of 39 observations for the 12 characters to obtain the s, x, F, and R_1 data in Tables 2 and 3. Also, from past experience with the group *Strobi*, it seems that 30-40 random samples are required for an initial character survey. Estimates of sampling (Table 3) for further studies of characters Q_1 to Q_{12} for taxa pairs

AB, *AC* and *BC* indicate that a relatively small number of specimens is required to exhibit statistical significance for most traits. A maximum of ten samples of each species within a pair would be required to detect a difference at the 5% level of confidence in 28 of the 36 possible character-taxa pair combinations and 20 samples to detect differences at the 1% level for 28 out of 36. These are reasonable sample sizes with which to work, and the number of characters, if definitive, could be expanded to give a more precise evaluation of a total difference. Note the direct relationship (Table 3) between the reliability index and the number of samples required. Low or negative R_I values correspond to higher sample numbers. Large sample sizes, e.g. 1352 and 227 for *BC*-Q_{10} and Q_{11} would require a prohibitive amount of observation time, so these characters are best not measured.. The time saved could be better spent on other observations such as those which follow.

SEED AND SEEDLING CHARACTERISTICS

Differences in seed weight of the three species used in the progeny tests are given in Table 5. To determine the accurate weight of sound seed each lot was first floated in 95% ethyl alcohol to separate the denser, sound seed from the buoyant, partially filled seed. After winnowing, the seeds were floated and it was discovered that about 10% of the seed were blank. Based on this unit of malformed seed and experiences with the other group *Strobi* seed, we converted the reported weights (Anon 1948: 269) of *P. monticola* and *P. strobus* to arrive at 53,460 per kg which compared very closely to our data for the two species. The large number of 60,000 seed per kg for *A* is related to the smaller size of the individual seed. The smaller seed may be linked to the ability of propagules with reduced endosperm to survive in the favorable growing and germinating conditions within the natural range of *A*.

The seed of all three species, in either the stratified or unstratified condition, began to germinate within 10 to 16 days after sowing (Table 5). In contrast to *B* and *C*, the

germination period for *A* had ceased 37 days after initiation of the test — also, the germination values for either treatment were identical. On the other hand, unstratified seed of *B* and *C* had considerably lower values than those stratified and some seed of both treatments had not germinated at the end of the test. The marked contrast in germination values between *A* and *B* or *C* is related to a major physiological difference within the phylad germination regime.

Under uniform growing conditions in a greenhouse the seed sources of *A* produced seedlings with longer hypocotyl and cotyledon length. *A* was significantly larger than *B* and *C*, but *B* was smallest. Larger numbers of samples are required to determine the variability within *B* and *C*, but the 30 sources of *A* seemed adequate to assess some infraspecific variation. Cotyledon numbers were not significantly different from one another although *C* had a slightly higher range and mean. Englemann (1880) reported 6-9 for *B* and 7-11 for *C*. Of all the seedling characteristics examined in this study, cotyledon number was most uniform and of least diagnostic value.

Shaw (1914: 1) suggested that cotyledon morphology and number are unreliable for species identification unless there are distinct numerical differences between species. In a recent study of the *Pinus flexilis* - *P. strobiformis* complex (Andresen and Steinhoff 1965), a significant difference was found in numbers of cotyledons with a mean of 8.8 for *P. flexilis* and a mean of 11.5 for *P. strobiformis*.

In addition to the above seedling characteristics, there was a difference in growth of secondary leaves and bud setting. As might be expected, because of its southern origin (Mirov 1962), *A* produced secondary leaves much earlier than either *B* or *C*. No secondary leaves were formed on either *B* or *C* during the first 200 days of observation. Also, *A* did not produce any dormant buds, for as soon as a bud was formed it produced continuous growth of leaves. Definite dormant buds did form on *B* and *C*. In the course of my

field work in December 1962, I observed numerous *P. chiapensis* south of Sola de Vega, Oaxaca, Mexico, which had produced several increments of cones the past growing season and with a few trees undergoing anthesis. Mr. Boone Hallberg (personal correspondence) has noted this phenomenon for several years and reports that an average stand in Oaxaca has the following periodicity of cone maturation:

Percent of Trees	Date of Maturation
20	20 July + second crop about 20 November
10	1-20 August
60	25 August - 15 September
10	15 September - 10 October

Mirov (1962) also observed that *P. oocarpa* in Nicaragua and other tropical pines are characterized by accelerated and uninterrupted growth rhythms. Only one year is required for seed set after pollination.

CONCLUSIONS

Coefficient of divergence values indicate a much closer morphological affinity between *Pinus strobus* and *P. monticola* than between *P. strobus* and the former variety *chiapensis*. The wide divergence between *P. chiapensis* and *P. strobus* provides one form of biometric evidence to argue against the opinions of earlier writers advocating that the two taxa should be conspecific. With the available *C.D.* values and the sustantiating data that follow, little doubt remains that *P. chiapensis* is a distinct species. An analysis of the more statistically significant characters that discriminate *P. chiapensis* from *P. strobus* reveals that *P. chiapensis* differs by having: (1) 25% more leaf serrations per unit length, (2) leaves that are 31% longer, (3) cone-scale apophyses that are truncate and 20% shorter, (4) extremely thin and wavy apophysis margins, (5) no reflexed scales contiguous to the peduncle, (6) 13% more seed per kg, (7) seed that germinates rapidly and uniformly without after-

ripening, and (8) continuous growth in the primary seedling stage without formation of dormant buds.

Ecologically, *P. monticola* and *P. strobus* grow within similar sub-boreal to cool temperate habitats. Although there undoubtedly are clinal or ecotypic variants (Hanover 1962; Mergen 1963; Wright, Lemmien and Bright 1963) within the geographic distribution of the two species, three omnipotent growth factors are present: (1) both species are influenced by annual photoperiodic cycles of short and long days that occur between 34° and 52° N. Lat., (2) precipitation ranges from 500 to 2000 mm (with up to 3450 in Coastal Washington) with pronounced dry periods during the summer months, and (3) temperatures are low enough to induce marked winter dormancy of three to six months. On the other hand, *P. chiapensis* is subjected to sub-equatorial insolation from 15° to 20° N. Lat. and is under the influence of a humid, warm-temperate climate associated with abundant precipitation concentrated in the summer months. In addition, this effective precipitation is further enhanced by frequent mountain fogs. Leopold (1950) described the *P. chiapensis* phyto-association as a tropical cloud forest while Beard (1944) termed it a temperate rain forest. Even though most *P. chiapensis* forests are limited to subtropical or warm-temperate climates there are exceptional isolated stands that occasionally are exposed to freezing temperatures.

In addition to the foregoing morphological and ecological divergences there also are ancient phytogeographical divarications that are extremely important when considering the origin of *Pinus chiapensis*. I believe that the original dispersal of the phylogenitors of *P. chiapensis*, *P. monticola*, and *P. strobus* was accomplished at least by early Eocene and that later but similar forms, morphologically and physiologically allied to the three contemporary taxa, were isolated from one another by late Pliocene. My reasoning follows:

Substantial evidence (Gausen 1960) of an ancient Hap-

loxylon pine flora richer and more diverse than the subgenus now extant has been revealed in the fossil record of the late Mesozoic and Arcto-Tertiary forests. With the advent of accelerated climatic change in the pre-Pliocene (Good 1953: 263), xeric climatic bands evolved (Schwartzbach 1963) that were unfavorable to the mesophytic plants of the southern portion of the Arcto-Tertiary biome. These latitudinally oriented zones contributed to the formidable hiatus which first isolated the early Quaternary progenitors of such contemporay pine relicts as *Pinus ayacahuite*, *P. chiapensis*, *P. griffithii*, *P. parviflora*, and *P. peuce*. In the early Pliocene of North America pronounced orogenesis contributed to a secondary discontinuity that further divided the forests above 25° North Latitude into eastern and western disjuncts. It was then, in the forested and mountainous areas of the Appalachians, the Pacific North West, and the southern Mexican-Guatemalan highlands, that the immediate ancestors of *P. chiapensis*, *P. monticola*, and *P. strobus* persisted in competition with their associates.

Thus, prior to the continental and montane glaciation of the Pleistocene, isolation of the phylad segregates was complete and to this day final. The waves of subsequent Pleistocene ice with their periglacial climatic regimes undoubtedly caused areal concentration of both *P. monticola* and *P. strobus*. However, the cooler temperatures and neopluvial conditions that were contemporary with glaciation did not, as Deevey (1949), Dressler (1954), and Sharp (1953) suggest, create an ameliorated environment across the semi-arid Texan hiatus that would have permitted the mesophytic phyto-associations of the southeastern United States to reach and penetrate the montane regions of eastern and southern Mexico.

Martin and Harrell (1957) observed that further detailed ecologic and taxonomic revisions should be made of the vicariads of these two biotas. For only with new evidence can the theory of mid-Cenozoic disjunction be expanded.

Finally, the divergence patterns and biometric differentials within the Holocene *Pinus chiapensis-monticola-strobus* phylad provide one such example of floristic confirmation of pre-Pleistocene isolation of the montane forests of southeastern Mexico, as suggested by McVaugh (1952); Martin and Harrell 1957; and Steyermark 1950.

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Table 1. Computation and Comparison of Coefficients of Divergence within the *Pinus chiapensis* — *P. monticola* — *P. strobus* Complex. Based on Means[1] of Characters Q_1 to Q_{12} for Taxa *A* to *C*.

Taxa	Parameter Means											
	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Q_7	Q_8	Q_9	Q_{10}	Q_{11}	Q_{12}
A	104.6	0.65	0.0062	12.9	4.3	87.7	17.7	9.9	1.79	22.4	2.5	0.04
B	68.1	0.92	0.0135	3.1	4.0	110.8	20.0	14.2	1.41	16.1	1.0	13.10
C	72.7	0.67	0.0092	6.1	3.4	67.6	16.4	12.4	1.32	16.4	1.1	7.00

Coefficients of Divergence, C. D., derived from the above data and means of 39 randomly selected samples from same populations values:

Taxa with all samples	with 39 samples			species pair			
	Leaf	cone	aggre-gate	leaf	cone	aggre-gate	
BC	.187	.155	.169	.189	.145	.165	*P. monticola* vs. *P. strobus*
AC	.206	.414	.343	.207	.418	.346	*P. chiapensis* vs. *P. strobus*
AB	.343	.424	.392	.348	.423	.393	*P. chiapensis* vs. *P. monticola*

[1] In the above summary of means let:
A denote 60 foliage samples and 40 cone samples of *Pinus chiapensis* collected from individual trees found in southern Mexico, and northern Guatemala.
B denote 120 foliage samples and 45 cone samples of *Pinus monticola* collected from individual trees found in southwestern Canada and the northwestern United States.
C denote 300 foliage samples and 47 cone samples of *Pinus strobus* collected from individual trees found in the Lake States, and the northeastern and southeastern United States,
and let following Q_1 to Q_{12} represent:

Q_1 total leaf length in mm
Q_2 leaf width in mm
Q_3 ratio of leaf width to leaf length Q_2/Q_1
Q_4 number of serrations per 5 mm interval of leaf edge at leaf center

Q_5 number of stomatal lines on vertral leaf surface
Q_6 total number of ovuliferous scales of mature cone
Q_7 width of scale apophysis in mm
Q_8 Length of scale apophysis in mm
Q_9 ratio of apophysis width to length Q_7/Q_8
Q_{10} length of cone peduncle in mm
Q_{11} involutions of edges of central scales, range from 0 to 4
Q_{12} number of reflexed basal-scales contiguous to peduncle; range from 0 to 18

To calculate any C. D., the following general formula was used:

$$C.D._{AC} = \sqrt{\frac{(a_1 - b_1)^2 + (a_2 - b_2)^2 + \ldots + (a_{12} - b_{12})^2}{k}}$$

where: $a_1 = \frac{A_1}{A_1 + B_1}$; $b = \frac{B_1}{A_1 + B_1}$ for Q_1 etc.

k = no. of characters, or 12 in this study

Table 2. Means and standard deviations of characters $Q_1 \ldots Q_{12}$ for *Pinus chiapensis* (*A*), *P. monticola* (*B*), and *P. strobus* (*C*), derived from 39 random samples. F statistics for species pairs *AB*, *AC*, and *BC* incorporate 1 and 38 d.F.

Character	*Pinus chiapensis*		*Pinus monticola*		*Pinus strobus*		F Statistics[1]		
	$\overline{X}$	s^2	$\overline{X}$	s	$\overline{X}$	s	*AB*	*AC*	*BC*
Q_1	106.51	14.44	69.21	16.42	77.97	12.29	113.51	88.30	7.13
Q_2	0.66	0.06	0.95	0.12	0.68	0.08	203.47	2.97	142.09
Q_3	0.0062	0.0008	0.0148	0.0042	0.0089	0.0013	154.83	121.90	69.46
Q_4	12.92	1.84	3.15	1.84	5.69	1.45	548.54	370.60	45.61
Q_5	4.33	0.83	4.09	0.89	3.46	0.77	1.46	23.20	11.41
Q_6	87.72	9.08	114.95	29.68	68.36	12.90	30.03	58.76	80.85
Q_7	17.74	1.82	20.10	3.14	16.49	1.50	16.53	11.08	42.17
Q_8	9.95	1.15	14.33	2.14	12.54	1.74	126.87	60.02	16.44
Q_9	1.80	0.22	1.41	0 23	1.33	0.17	55.03	106.02	2.75
Q_{10}	25.10	5.84	15.77	4.66	16.10	3.10	60.82	72.26	0.14
Q_{11}	2.43	0.72	1.10	0.31	1.05	0.22	113.66	132.23	0.71
Q_{12}	0.03	—	12.54	2.39	7.41	1.63	1064.13	794.19	122.13

[1]Values under 2.98 are non-significant. Value of 7.13 is significant at 5% confidence level. Values greater than 11.07 are significant at 1% confidence level.

[2]The coefficient of variation (C. V.) discussed in the text is calculated from the formula C. V. $= s^2\overline{X}$ (100). For example in A — Q C. V. $= (14.44)^2/106.51$ (100) $= 13.6$

Table 3. Character reliability indices (R_1)[1] and number of samples[2] of each taxon required to detect significant differences at the 5% and 1% level within species pairs *AB*, *AC*, and *BC*.

Character	Reliability index			Samples needed to detect differences					
	AB	*AC*	*BC*	*AB*		*AC*		*BC*	
				5%	1%	5%	1%	5%	1%
Q_1	.983	.978	.754	3	5	4[3]	6	22	39
Q_2	.990	.497	.986	2	3	50	82	3	4
Q_3	.987	.984	.972	2	4	3	4	5	6
Q_4	.996	.995	.957	2	3	2	3	7	8
Q_5	.189	.917	.839	99	157	8	14	15	26
Q_6	.936	.965	.976	7	11	6	7	5	6
Q_7	.883	.835	.954	10	17	16	27	7	8
Q_8	.984	.967	.885	3	4	5	7	10	17
Q_9	.964	.959	.288	6	7	4	5	68	108
Q_{10}	.968	.973	—.758	6	7	5	6	1352	2160
Q_{11}	.983	.985	—.169	4	5	3	4	227	354
Q_{12}	.998	.997	.984	1	1	1	1	3	4

[1]Although R_1, as the intraclass correlation, is more often used to compare characters between genetically related individuals, it also serves here as a statistic to evaluate character weight. It is computed from the model $R_1 = \sigma^2_B / (\sigma^2_B + \sigma^2_W)$ where σ^2_B is the between taxa component of the total variance and σ^2_W is the within component of the total variance for any one character. In AB—Q_1, .983 means that 98.3% of the proportionate variance is related to differences between taxa rather than within taxa. High R_1 values indicate "strong" characters of differentiation.

[2]Sample sizes were determined by solving for n in the formula $n = 2\,Vt^2/(\bar{X}_1 - \bar{X}_2)$ which was derived from the model of "student's" t. In our sense, n = degrees of freedom or sample size, V = pooled variance of a species pair, t=estimated value from "student's" t-distribution, $\bar{X}_1 + \bar{X}_2$ = means of character X in species 1 and 2 respectively.

[3]To calculate the number 4 proceed as follows: The variance (σ^2) of Q_1 for *A* is 207.36 and for *C* is 151.29 (pooled $V_1 + V_2$ should be divided by 2), the mean leaf length for *A* is 106.5 and 78.0 for *C*; these values substituted in the n formula give: $n = 2/2\ (358.65)t^2/(28.5)^2 = .442t^2$. Since .978 is a high R_i and indicative of a low n, substitute n = 2 to find an empirical t; ($t = 2n - 2$):

with 2 df
$2 = .442t^2$
t for 4—2 df
at 5% = 4.30
$2 = .442(18.50)$
$2 = 8.18$
but $2 \nmid 8.18$

so try 6 df
$6 = .442t^2$
t for 12—2 df
at 5% = 2.23t
$6 = .442(4.97)$
$6 = 2.20$
but $6 \nmid 2.20$

so try 3 df
$3 = .442t^2$
for 6—2 df at 5% = 2.78
$3 = .442(7.73)$
$3 = 3.42$ rounded = 4
so the conservative n = 4

with 4 df the "t" side was only 2.63, so the appropriate n is reached the first time the "t" side of the equation exceeds the "n" side.

Table 4. Internal leaf characters: number of resin canals and succulence represented by percents of moisture and intercellular space of *P. chiapensis*, *P. monticola*, *P. strobus*, and hybrid *P. monticola* X *strobus* (*D*).

Taxa	Resin Canals Mean No.	Std. dev.	Range	Taxa	Succulence % Moisture	% Intercellular sp.
D	1.89[1]	.581	0-4	A	67.75**	40**
B	2.25	.266	2-3	*B*	58.89	10
A	2.52	.207	2-3	*C*	58.76	10
C	2.57	.176	2-3	*D*	58.26	10

[1]Taxa *D* and *B* or *A* and *C* not significantly different from each other in number of resin canals but former pair is significantly different from latter at 1% level using the value of t.

**Taxa *A* values significant at 1% level, *B* to *D* non-significant.

Table 5. Seed and Seedling Characteristics of *Pinus chiapensis*, *P. monticola*, and *P. strobus*.

Taxa	Seed per kg		Seed Germination rate in days		Germination values[3]	
	$\overline{X}$	Range	Unstrat.[1]	Strat.[2]	Unstrat.	Strat.
A	61,100	46,900 to 104,200	10 to 37	10 to 37	10.35	10.35
B	52,300	39,400 to 67,800	10 to 186+	13 to 186+	0.04	0.48
C	53,800	47,000 to 66,700	16 to 186+	13 to 186+	0.48	1.28

[1]Unstratified seed stored dry at 4°C. for 60 days.

[2] Seed stratified in moist peatmoss at 4°C. for 60 days.

[3]Germination value = greatest cumulative number of seed that germinated in fewest days multiplied by total percent germinated, divided by total number of days in test period (McLemore and Czabator 1961).

	Seedlings					
	Hypocotyl Length mm		Length mm		Cotyledon Number	
	$\overline{X}$	Range	$\overline{X}$	Range	$\overline{X}$	Range
A	39	20 to 70	28	20 to 40	8	6 to 10
B	20	15 to 35	18	14 to 25	8	7 to 10
C	31	18 to 44	25	15 to 30	10	8 to 12

CYTOGEOGRAPHY OF ORONTIUM AQUATICUM (ARACEAE)[1]

JOHN W. GREAR, JR.*

The Golden Club, *Orontium aquaticum* L., constitutes a monotypic genus of subfamily Calloidae Engl., an alliance also including the genera *Symplocarpus, Lysichitum* and *Calla.* These genera are interpreted as temperate or subarctic extensions of the predominantly tropical family Araceae. All but *Orontium* are represented in eastern Asia and in North America, and thereby lend strength to the affinities existing between the floras of these regions.

Morphologically, *Orontium* is regarded as a derived, highly modified genus without any near relatives. The geographical distribution of the genus and its allies lends considerable support to this view.

Orontium aquaticum is a perennial herb possessing a deep-seated, firmly-anchored, vertical rhizome. Its distribution (Fig. 1) is restricted to the eastern United States, where it occurs on the Coastal Plain in aquatic or semi-aquatic habitats such as bogs, marshes, streams and pools, and in similar habitats of the inland physiographic provinces, sometimes up to 2800 ft. in the mountains. However, lack of suitable habitats has localized its distribution in the Appalachian Highlands.

To date there has been no comprehensive morphological study of *Orontium*. Harshberger (1916), in his account of the vegetation of the New Jersey pine barrens, described and illustrated the anatomy of the leaf in considerable detail. In a meticulous study of the floral structure,

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[1]Condensed from a thesis submitted to the Department of Biology in partial fulfillment of the requirements for the degree of Master of Science in the Department of Biology, Vanderbilt University, January 1963.

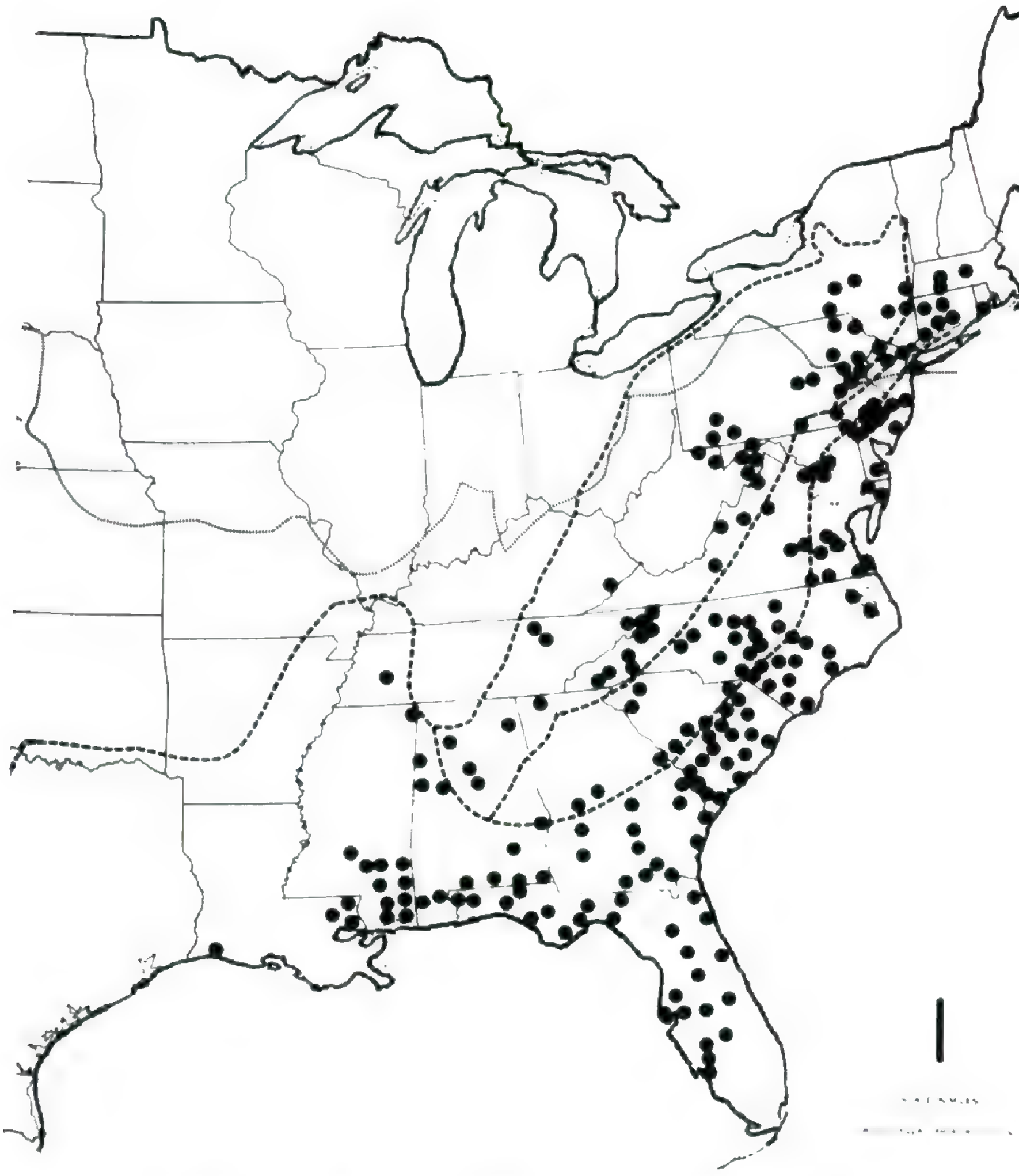

Fig. 1. Map showing distribution of *Orontium* based upon records documented by herbarium specimens. The southernmost extent of glaciation is shown by the dotted line. The heavy broken lines separate respectively the Coastal Plain, Piedmont and Appalachian highlands, including the Blue Ridge, Ridge and Valley and Appalachian Plateaus provinces.

Schaffner (1937) pointed out inaccuracies of previous descriptions and reported a wide range of variation among the flowers on a single spadix. In a taxonomic study of the temperate North American Araceae, Huttleston, (1953, unpublished) found the chromosome number of *Orontium* to be $2n=28$, a number different from that previously found by Malvesin-Fabre ($2n=24$, 1945, un-

published) see Darlington and Wylie, 1956. In the treatment of the Arales for the generic flora of the Southeastern United States, Wilson (1960) summarized the existing information concerning *Orontium,* indicating that the morphological and biological details of this plant warranted further investigation.

The present investigation was prompted by conflicting statements about the chromosome number as well as the relationship between this data and the distribution of the plant in all major physiographic provinces of the Eastern United States. It was further felt that by correlating cytological with geographical data, some insight into migrational patterns might be gained.

Through the correlation of past geological history with cytological, morphological, taxonomical and ecological evidence, it is sometimes possible to postulate an earlier distribution and possible migration route, which would explain the present distribution of *Orontium.* The Araceae are a predominantly tropical family and during the Tertiary period, when tropical conditions prevailed farther northward, a wide range of plants such as temperate conifers, deciduous hardwoods and warm-temperate plants, including araceous plants, ranged to high northern latitudes, far beyond the limits of the present tropics.

In *Symplocarpus* and *Lysichitum,* the two genera most closely related to *Orontium,* the migration route to present ranges appears to have been from the region of the Arcto-Tertiary flora of the then tropical boreal regions of western North America and eastern Asia (Rosendahl, 1911). Subsequent climatic changes forced them to migrate southward. *Symplocarpus* apparently migrated to eastern North America while *Lysichitum* remained in the West. As with *Orontium,* plants in both of these genera require a very moist or wet habitat. *Symplocarpus foetidus* (L.) Nutt., constituting a monotypic genus, occurs in two widely disjunct areas — eastern Asia and eastern United States. *Lysichitum* consists of two closely related species: *L. camtschatcense* (L.) Schott, the Asiatic one, occurs in Japan

and Kamtschatka, and its American counterpart, *L. americanum* Hultén and St. John, is distributed in western North America between California and Alaska (Hultén & St. John, 1931). Fossil evidence substantiating a more extensive distribution for araceous plants has been found in Spitsbergen (presumably as imprints) referable to extant species. An aquatic aroid from the Tertiary flora, *Acorus brachystachys*, has been described recently by Schloemer-Jager from the Brogger Peninsula of the same island (Andrews, 1961).

Cockerell (1926) gives evidence supporting a once more westerly distribution of *Orontium* in North America. The relevant specimen consisted of a spadix, incomplete at the distal, fertile end, and its sterile stalk. Although the identity of the specimen is uncertain, it was sufficiently characteristic, according to the author, to be referred to this genus. The only character found to separate the fossil plant from the modern species was a lack of thickening of the scape below the spadix. Cockerell states that "this fossil may take the name *Orontium fossile* n. sp.; it adds one more to the numerous examples of genera now existing in the Eastern and Southern states, but found in the Rocky Mountain Region only in the fossil state."

If *Orontium* and related genera migrated from the region of the Arcto-Tertiary flora, then they were probably distributed over a wide range during the late Cretaceous and early Tertiary, from the east coast of the continent to the region of Colorado or perhaps even further west, under the influence of the equable climate of the era. At that period, the Appalachian Uplands were essentially a peneplain, affording ideal conditions for coastal-plain types such as *Orontium* in the streams and swampy areas. Uplift of this old Cretaceous (Schooley) peneplain during the Miocene epoch, and the accompanying climatic changes and erosion cycles resulted in greatly altered conditions. The climate to the west became much more arid, eliminating possible populations of *Orontium* west of the Mississippi River. A more restricted distribution was placed upon the

species in the Appalachian Region and only relict populations survived in the favorable mesophytic and hydrophytic habitats of the newly elevated highlands. With the later recession of the sea, the newly-emergent Coastal Plain became available to the migrating species from the uplands, which found optimum conditions in the bog-marsh habitats. An account of the Coastal Plain element in the flora of the Appalachian uplands, correlated with physiographic history of the provinces concerned, has been described thoroughly by Kearney (1900), Harshberger (1903), Fernald (1931, 1937), Braun (1937), Carr (1938), Core (1938), *et al.*

Observation of the map (Fig. 1) shows that the present range of *Orontium* has extended into the formerly glaciated region in some of the Northeast. Peattie (1922) reports the occurrence of *Orontium* from as far inside the glacial boundary as Lake Oneida, New York. During the glacial and interglacial stages of the Pleistocene, the climatic fluctuations probably caused a retreat of the species to refugia farther south of the advancing ice. From these refugia, when the ice receded for the final time, probably it migrated to its present northernmost limits.

As stated earlier, varying chromosome numbers for *Orontium* have been reported. Huttleston (1953) has counted 28 somatic chromosomes from root tip squashes of four plants, two from Duval County, Florida, and two from Middlesex County, New Jersey. Both of these locations are in the Atlantic Coastal Plain. A different count, of 24 chromosomes, has been reported by Malvesin-Fabre (1945) in a thesis submitted to the University of Bordeaux, France. As this work was unobtainable, the source and the state of the studied plant material are not known to the present writer. However, the possibility of different numbers suggested that some correlation might exist between chromosome number and geographical distribution.

It was planned originally to work with meiotic material, but flowers from plants collected in early April of 1961

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Fig. 2. Chromosomes of *Orontium*. First meiotic metaphase. Material from Fentress County, Tennessee. × approx. 500.

had already undergone meiosis. In collections made in early September of the same year, meiosis had already occurred in young flowers that would not make their appearance until the following spring. It appears that the greater part of the meiotic process probably occurs sometime during the summer season, more than eight months in advance of of anthesis the following spring.

Only one determination of chromosome number was made from meiotic material. This was obtained quite by chance from the tip of an inflorescence collected in Fentress County, Tennessee, April 1961, in which meiosis was complete. A few pollen mother cells of the young sporogenous tissue showed 26 chromosomes at the first meiotic metaphase, the number not yet having been reduced. The inflorescence was collected in Newcomer's solution and the squash was made using acetocarmine. Some of the chromosomes exhibited a tendency to stick together, as evidenced by strand-like connections between them (Fig. 2). Because of the uncertainty relating to the exact time of meiosis, all other work was done with root tip chromosomes.

Living samples of *Orontium*, variously consisting of fruits, seedlings and mature plants, were obtained from various sources for root tip material. The samples were maintained in the green house in concrete water tanks during the course of investigation. Fresh, vigorously-growing

root tips about 1 cm. in diameter were excised immediately before treatment.

The live tips were pretreated with α-bromonapthalene to inhibit spindle formation, shrink the chromosomes and render the centromeres more evident. The method of Tijo and Levan (1950), utilizing 8-hydroxyquinoline as a pretreatment agent, proved less effective in fixing the metaphase than α-bromonapthalene even though other conditions were constant. The root tips were then killed and fixed with alcohol-acetic acid (3:1) and stained with aceto-orcein after the method of LaCour (1941). The meristematic tip of the root was then excised and squashed in a drop of 45% acetic acid. Mitotic chromosome counts were obtained from 24 different populations and in every instance the diploid number was 26. Neither of the previosly reported numbers ($2n = 24, 28$) was ever found, although attempts to verify Huttleston's Duval County report were made using material collected from the same site. The chromosomes are very large, intensely-staining and easily observed where the squash preparation is good. The position of the majority of the centromeres is median (iso-brachial), a feature regarded by some workers (e.g. Levitzky, 1931) as representing the generalized or primitive condition. The chromosomes of one pair have clearly discernable satellites (Fig. 3). A tendency toward fragmentation at the centromere may account for Huttleston's report of $2n = 28$. However, this was a random occurrence in the present study.

Because the chromosome number appeared the same in all plants examined, regardless of source, consideration was given karyotypic variation among populations. Graphic portrayal of chromosome arm length was attempted, but, because of differential shrinkage and swelling of the chromosome arms it was not possible to match homologous chromosomes. Therefore, no correlation was found between quantitative chromosomal data and the geographical source of the samples studied. The only two chromosomes that could be paired with any degree of certainty were the two

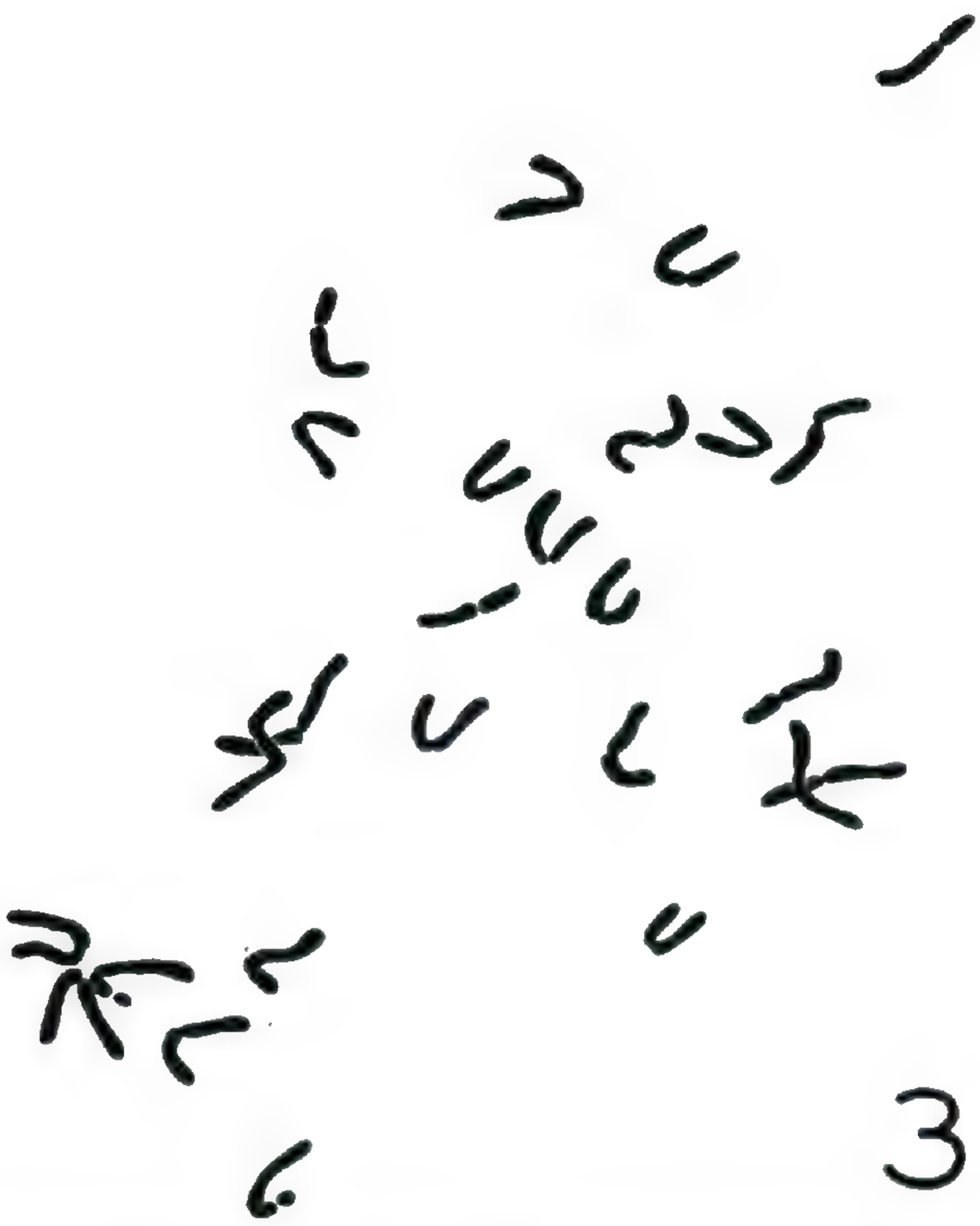

Fig. 3. Chromosomes of *Orontium*. Mitotic chromosomes. Material from Cameron Parish, Louisiana. × approx. 700.

with satellites. Until a more reliable procedure is developed, permitting assessment of differences in linear dimensions, the quantitative information must be considered insignificant.

It appears that *Orontium* chromosomes would be particularly suitable for differential staining (see Fukuda and Kozuka, 1958, for work on *Trillium*), and that the homologous pairs of chromosomes might thereby be identified. There was some indication of differential stainability of the chromosomes of *Orontium* during the present investigation and this suggests the possibility of relating the populations to distribution.

SUMMARY

Information obtained from this study contributes to knowledge of the cytology of *Orontium*, a monotypic genus of the Araceae. The diploid chromosome number of all populations studied is 26, irrespective of geographical

source. Two satellites or secondary constrictions are evident in every karyotype and the chromosomes are extremely large (ca. 20μ), exhibiting essentially median centromeres.

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AUTHORS OF PLANT GENERA AND THE INTERNATIONAL PLANT INDEX

REED C. ROLLINS

An impressive volume printed with the aid of computers and assembling in one place a lot of information heretofore somewhat scattered has recently appeared.[1] However, most botanists will not find the information to be of great intrinsic value and an occasional consultation of the work will probably suffice for their purposes.

The bulk of this paperbound book is devoted to an alphabetical listing of the "authors" accompanied by four columns under the headings, AUTHOR CODE, BORN, COUNTRY, and DIED. This is followed in double-column format by 62 pages of "author" listings, giving the author code in each instance. The final section gives a three-column listing of name abbreviation, author name and author code in a double-column format, followed by an addenda to each of the three lists.

If botanists did indeed take up and use the author code-order index for citation of author names of plants, as urged by Mr. Gould, it would be a radical departure from past practice. It would also involve giving up to the machine the essences of familiarity which link plant names with the men who gave them to the plants. We now have no difficulty in remembering that *Schlecht.* stands for *Schlechtendal* or *Schott* for Schott but how many botanists will remember that SCH794 is Schlechtendal and SCO794 is Schott? How can one be expected to remember that SHO904 is A. J. Sharp and SHA904 is W. M. Sharp? These unnecessary abbreviations reflect the choice by the authors of an inadequate system to handle the information they are trying to present.

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[1]Authors of Plant Genera, by Sydney W. Gould and Dorothy C. Noyce. International Plant Index 2: 1-336. 1965. The New York Botanical Garden, New York; The Connecticut Agricultural Experiment Station, Box 1106 (IPIx) New Haven, Connecticut 06504; $6.00 in U.S.A. and Canada, $6.50 in other countries.

It can be argued that having the names of the men of historical botany closely associated with the names of the plants they helped reveal to the public is of no great moment. However, it is not as simple as that. The name of the author, if it is known and recalled, helps put the name of the plant into its historical setting, which in turn helps with the geography and other matters concerning the plant itself. The richness of the presently used name content, with citations that are well understood and appreciated, will be greatly denuded by the device offered in the book under review. In addition, one will be forced to look up, on every occasion, the correct author code. This will be a nuisance for taxonomists; for non-taxonomists, it will make author citations both incomprehensible and ridiculous. Are citations such as *Rhododendron canadense* (LIN707)BSP859 or *Buchloë dactyloides* (NUT786)ENG809 to the advantage of either taxonomy or plant sciences generally?

RELATION OF STATED CONTENT TO ACTUAL CONTENT: The book is entitled "Authors of Plant Genera." In the introduction, it is stated that, "the work encompasses . . . . . the authors who have named . . . . the genera of the entire plant kingdom." Since great stress is laid on accuracy by the authors, for example, p. 9, Mr. Gould states, "the work of IPIx is probably already 95% accurate in each division" and the advertising flyer starts off with, "Computer Accuracy for Your Reference Library", one naturally expects the book to be accurate. However, a quick glance reveals that scores of names of botanists and others are included, who not only did not name any genus of plants but no other taxon of a category higher than genus as well. In fact, when the list is analyzed a little further, one finds the names of many persons who have not named any plant taxon whatever. Many are not botanists at all. One finds librarians, zoologists, friends of the authors and the authors themselves, none of whom named genera. Is this the kind of capriciousness that should characterize an accurate scholarly work? Do the authors think they are playing games with the ma-

terials of science? What then are the criteria for the inclusion of a name in the "Authors of Plant Genera"?

ACCURACY AND COMPLETENESS: One reliable and readily available source that should have been a major check-point for "Authors of Plant Genera" is Index Nominum Genericorum, published by the International Association for Plant Taxonomy. Apparently this recent authentic work, now only partially published but having over 21,000 cards in it, was hardly utilized at all. This circumstance permits us to use it as a check for the accuracy of the book under review.

The alphabet from Aa to Af, amounting to approximately 400 cards of Index Nominum Genericorum, was checked against "Authors of Plant Genera" by a colleague. This number turned up six errors or omissions, of which five were complete omissions of botanists who had described genera of plants. If this rate of omission holds when checked against the rest of the Index Nominum Genericorum presently available, it means that over 250 omissions of authors who named plant genera were carelessly left out of the book being billed as "the most complete work of its kind." If Index Nominum Genericorum were complete, one wonders how many thousands of names that legitimately should have been included in "Authors of Plant Genera" would be shown up by a check against it.

Checking for accuracy is a time consuming and uninspiring enterprise and one tends to turn to the quickest way of seeing whether the data given in a book stands up or not. We noticed that Leslie Andrew Garay and Clarence Garay are the same in the author code, page 86, and that he is alleged to be from Canada. Leslie Garay, who works nearby, tells me that he has never published under the name of Clarence Garay and has not been known under that name. Furthermore, he has been in the United States since 1957, and was born in Hungary. Although he did spend some years in Canada, the information on Garay is both inaccurate and misleading.

We know that Thomas Coulter was born, lived and died in Ireland, but on page 69 he is listed as England. On the

other hand, N. L. Bor is given as Ireland, although he specialized on the grasses of southeast Asia, spent much time there, and for many years he has been at Kew in England, where he has been professionally identified right down to the present. Oddly enough, although Edward Perceval Wright was born, worked and died in Ireland, apparently on the basis of a visit to the Seychelles Islands for six months in 1867, "Seychell. has become his "country of principal work or home." In short, every entry under this column must be checked by the user to determine its meaning and accuracy, if these are important to him.

Under the column "Country" the strangest designations appear. For example, S. America is given as a country many times, but so also are Argentina, Brazil, Colombia, etc., the true countries of South America. It must seem strange to the well known Argentinian botanists, Professors Arturo Burkart and Lorenzo R. Parodi, to read that their country is "S. America." I am surprised to see listed as countries: Patagonia, Sahara, Transvaal, South West Africa, etc. Certainly these subversions cannot be read as a sign of erudition on the part of the authors. One is led to ask, how can such sloppiness be supported as a crusade ostensibly to help librarians, taxonomists and plant scientists?

THE INTERNATIONAL PLANT INDEX: The two volumes so far published by IPIx, as poorly prepared as they are, can scarcely be said to have done any real harm. This is so because the content of each of them is readily found elsewhere in reliable sources and the real scholar will soon discover that the volumes are not worth bothering with, in spite of the exorbitant claims to the contrary. However, I am alarmed by the forecast that the third volume will be "Genera of the Plant Kingdom." If such a work is published with the same lack of understanding of botanical nomenclature and taxonomy, and the same disregard for the International Code of Botanical Nomenclature that is evident in the published work so far done by the people at International Plant Index, it will be a disaster much worse than

the appearance of the infamous volumes of Otto Kuntze[2] in the 1890's.

We have no quarrel with the use of computers or other data-processing machines to help organize and produce an index of plant names. Properly handled, such a single complete index would not only be extremely useful in itself but it could be the basis for encoding a wide range of botanical information that could then be made readily available. We part company with the organizers of IPIx when they insist on going beyond a simple index, yet use only books (and secondary sources, at that) as the basis for value judgements concerning the taxonomy of the plants whose names they are handling. In Family Names of the Plant Kingdom,[3] it is a simple fact that a value judgement was made every time a name was selected for use as as operative name. A taxnomic judgement was made every time a name was listed as a synonym. These are facts even though the authors specifically state that the contrary is the case.

The hundreds of value judgements made by the author of "Family Names" were completely unsupported and evidently were made without any real knowledge of the plants involved or of any reasons why one course of action should be taken in preference to another. The use of the word "operative" or some other designation such as "correct" or "in use" does not lessen the responsibility for making an acceptable choice. To be acceptable the name chosen has to stand up to the requirements of the science. It is not the business of an indexer to make choices where taxonomic judgements are involved, unless he can produce the scientific evidence to back up the choice. Quite obviously, Family Names of the Plant Kingdom is not an unbiased index and it cannot, therefore, be reliably used as an index. As a

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[2]Revisio Generum Plantarum. Pars I-III plus supplement. 1891-1898.

[3]Family Names of the Plant Kingdom, by Sydney W. Gould. International Plant Index 1: 1-111. 1962. For a review see Botanical Nomenclature, Punched Cards, and Machines, by C. E. Wood, Jr., R. S. Cowan and G. Buchheim. Taxon 12: 2-12. 1963.

reliable source of the proper name of a family, it is completely hopeless.

In his writing, Mr. Gould has lectured to taxonomists, quoting his favorite authors and giving naive analogies to telephone communication and space science. Unfortunately he has kept himself immune from even an elementary understanding of the basic ideas and tenets of taxonomy and nomenclature, the subjects in which he is apparently trying to attain an authoritative position.

The real danger that lies ahead arises from the fact that those most deeply committed to IPIx are untrained for the task they are trying to perform and will not listen to anyone knowledgeable enough to help them. Their supporters and advisers are equally lacking in an understanding of the problems involved. If the International Plant Index continues in the path so far laid down, taxonomists and botanists generally will be saddled with a nomenclatural mess, a heritage largely from those who have willfully or unwittingly given their support to IPIx.

GRAY HERBARIUM
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STUDIES IN THE CAPPARIDACEAE[1] VIII. POLANISIA DODECANDRA (L.) DC.: FURTHER NOTES ON ITS TYPIFICATION.

HUGH H. ILTIS[2]

In two studies in this series (Iltis 1954, 1958) it was maintained that the common American *Polanisia graveolens* Rafinesque should properly be called *P. dodecandra* (L.) DC., the latter based on *Cleome dodecandra* of Linnaeus's *Species Plantarum* (1753). However, in a recent generic review of the Caper family for the Southeastern United States, Ernst (1963: 90-91, footnote 6) casts serious doubts on the validity of this disposition, suggesting instead that the *C. dodecandra* L., based as it is on a description in the *Flora Zeylanica* (No. 242, p. 109), a work based in turn on Paul Hermann's Ceylon plants and drawings, is actually a hitherto unrecognized or misunderstood *Asiatic* species which should not be equated with the well-known American *Polanisia graveolens* Raf., the two being presumably totally different taxa. The present paper attempts to show that on the basis of the critical collections housed in London (and

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[1][Ed.: Published as Capparidaceae rather than Capparaceae at the request of the author.]

[2]I am much obliged to the Botanical Society of America for a grant-in-aid to attend the Xth International Botanical Congress in Edinburgh, and thus be privileged to visit London and its herbaria, and to Dr. Wallace Ernst, U. S. National Herbarium, Smithsonian Institution, Washington, for the careful presentation of his arguments in correspondence. The staffs of the Linnaean and British Museum herbaria, especially J. E. Dandy, Keeper of Botany, N. K. B. Robson, and D. Hillcoat have been most generous with their help, as has been my colleague John W. Thomson and particularly Mr. Dandy for constructive and instructive criticisms of the manuscript. To them, my very sincerest thanks. This research was supported in part by Research Committee of the University of Wisconsin on Funds from the Wisconsin Alumni Research Foundation.

thus on somewhat different grounds than previously), and on a careful reexamination of the texts involved in this argument, my original conclusions must still be considered valid: namely that *Cleome dodecandra* L. and *Polanisia graveolens* Raf. are synonymous. Therefore, *P. dodecandra* (L.) DC. is still the correct name for the American taxon.

The original Linnaean citation (Sp. Pl. ed. 1, 2: 672) of *Cleome dodecandra* reads as follows: "*dodecandra.* 5. *Cleome floribus dodecandris, foliis ternatis. Fl. Zeyl.* 242*". As was fully discussed in earlier studies (Iltis 1954, Ernst 1963), the two other following citations refer to other species.[3] The star after *Flora Zeylanica* indicates the presence of a good description in that work. As to the origin of the species, he reported it as "*Habitat in Indiiis*" meaning by that the warm regions of both Asia and America, as shown by the inclusion in synonomy of a Sloane plant from Jamaica.

As was pointed out previously (Iltis 1954), *the short description in the Flora Zeylanica is nevertheless a vivid and excellent one* (apparently having been made from living plants), and, with its reference to 8 stamens, 3-foliolate leaves, emarginate white petals, red pistil, unilateral gland and thick, hispid capsules, fits exactly only one taxon in the world, the American *Polanisia graveolens.* Thus, while Linnaeus' total conception of his species was confused if his diverse synonomy is considered, his own personal description of the plant in question is brilliantly clear.

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[3]While the third and last of these Linnaean polynomials clearly refers to the New World *C. serrata* Jacq., the second polynomial (and reference to "Burm. Zeyl. 216, t. 100 f. 1") was thought to refer to perhaps *C. burmannii* W. and A., or to *C. rutidosperma* DC., though, truly, the drawing is unidentifiable. In the Geneva Herbarium are several "Herbier Burmann" collections, including one that matches this drawing — a depauperate miserable specimen, about 15 cm tall, with one hidden flower, labelled "*Cleome dodecandra*" [by Burmann?], a plant that conceivably could be a young *C. viscosa* or *C. aspera,* or [doubtfully], as Briquet had annotated it, *C. burmannii.* Whatever taxon this specimen belongs to, the plant is much too poor for Linnaeus to have used in drawing up the excellent *Flora Zeylanica* description, and can thus not be considered type material.

However, the *Flora Zeylanica* is not based on American collections, but on collections of plants and drawings made in Ceylon in ca. 1670-1677. But how can we reconcile a temperate American plant in tropical Ceylon? Fortunately, these drawings and plants of Hermann's are still preserved in the British Museum of Natural History, where they may be studied. They are thus of immense scientific value. In the *Flora Zeylanica,* to quote Stearn (1957:119)," . . . only phrase-names are used but, as pointed out by Trimen (1887), when dealing with Ceylon plants in the *Species Plantarum,* 'Linnaeus was careful to quote under them the number of the *Fl. Zeylan.,* and thus the specimens of Hermann's herbarium become types for many of Linnaeus's species . . . especially as the large majority of the species in Hermann's herbarium are unrepresented in Linnaeus's own collection.' " Thus, when typifying a species described in the *Flora Zeylanica,* one must consult the Hermann herbarium!

Recently an opportunity presented itself to make a search for the type of *Cleome dodecandra,* and, with the generous help of Miss D. Hillcoat, the four volumes of the Hermann herbarium were examined page by page, specimen by specimen. Of the *Cleome* species cited in the *Flora Zeylanica,* the following were found to be represented by specimens:

C. gynandra, Fl. Zeyl. No. 239 (in vol. I, p. 1, and vol. III, p. 7);

C. viscosa, Fl. Zeyl. No. 241 (in vol. I, p. 75, and vol. III, p. 2);

C. monophylla, Fl. Zeyl. No. 243 (in vol. I, p. 52 and 57, and vol. III, p. 2).

There were no specimens for *C. icosandra, Fl. Zeyl.* No. 240, and, more importantly, there were none for *C. dodecandra Fl. Zeyl.* No. 242! Next, an examination of Hermann's *Icones* volume showed but two *Cleome* illustrations, one on page 421 (numbered 242 — was this number entered there

by Linnaeus.[4]), the other on page 24, neither of which could be *C. dodecandra*. Both appear to represent normal plants of *Cleome aspera*, the latter figure (p.24) but a small-scale copy of the first, and matching very well such *Cleome aspera* collections as *Beddome 203* from Madras, India (BM!) or the *C. aspera* type (K!). Thus, neither Hermann's drawings nor his herbarium contain any material referable to Linnaeus's *Cleome dodecandra*. Futhermore, we can follow neither Trimen (1887:146), who equated No. 242 of the *Flora Zeylanica* (i.e. *C. dodecandra*, with the first of these drawings (No. 242), as "*C. viscosa* L. var.", nor Ernst (1963), who, following Trimen, suggests that this drawing should be taken as a type of *C. dodecandra*. For these drawings, both evidently of the same plant, represent *C. aspera*, a 6-staminate, glandless, slender-fruited species, and in no way agree with Linnaeus's excellent descriptions of *C. dodecandra*. As a matter of fact, how could Linnaeus have obtained all this detail, as well as flower and pistil color, from this simple drawing?

At this point Mr. Dandy very kindly (and literally) came to the rescue, for in examining the *Flora Zeylanica* text (p. 109) he *immediately noted a very significant omission in the Cleome dodecandra description*, one that neither I nor Ernst was aware of: namely that *Linnaeus does not cite (as he usually does in the Flora Zeylanica) any collection or plate of Hermann's Musaeum Zeylanicum following the description of C. dodecandra! This can only mean that Linneaus did not have a Hermann specimen in front of him when he drew up this description*, but rather some plant of different origin, a plant which he for some reason must have believed should belong in a book on Ceylon plants. Very possibly, he equated one of his garden plants with Burmann's Ceylon drawing which, being based on a Ceylon plant, was to be included in *Flora Zeylanica* whether or not

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[4]According to Trimen (1887:130), "In the [Hermann] herbarium itself he [Linnaeus] has added to Hermann's labels a reference to the number of the species in his own 'Flora Zeylanica.'"

Hermann had collected it. In any case, he must have had his reasons, for the inclusion in the *Flora Zeylanica* of plants other than those collected by Hermann in Ceylon is a rare (though not unknown) occurrence. That an error on the part of Linnaeus is involved here was deduced earlier on somewhat different grounds (Iltis 1954: 67, footnote).

Since Linnaeus evidently had a plant available when writing the description of *C. dodecandra,* we are now again forced to look for a specimen, and the logical place to seek is in the Linnaean Herbarium. There, the one plant that clearly fulfills all requirements is sheet 850.12 (Savage 1945). In my earlier studies I could only guess at the identity of this plant from the poor photograph then available. Now, however, after an examination of the actual specimen, there is no doubt that this plant is indeed the same as *Polanisia graveolens* Raf., with the emarginate petals, and at least 8 stamens (inflorescence very young and not vigorous) clearly visible.

Since Linnaeus mentions "*capsula crassa, hispida*", he must have had in hand (or in memory) the characteristically thick and hispid-fruited plants of this species, probably from his Uppsala garden, where the species was evidently in cultivation, the specimen in question (850.12) having a small tag glued to its stem that reads "H. U. 12 andr" [*Hortus Upsaliensis dodecandra*]. This cultivated plant, therefore, we must take as the type of *Cleome dodecandra* L.: it is clearly the only specimen that agrees (and then exceedingly well) with the original description, and is furthermore labelled by that name with a tag that we have reason to believe is contemporaneous with the publication of the *Flora Zeylanica* (1747) or earlier. As to the country of origin, we can only guess the Northeastern United States or adjoining Canada. Linnaeus evidently did not know the source, but believed it to be identical to that of the Burman and Boerhaave plants from tropical Asia cited in *Flora Zeylanica.*

Complicating this story are the whole series of errors that occurred in the labelling (contemporaneously or subse-

quent to 1753?) of the *Cleome* collections in Linnaeus's herbarium as well as in his texts. Thus: 1) he was mistaken in later writing on sheet 850.12 the name "*viscosa*" (though the older tag label says "H. U. 12 andr"!). Whoever scribbled this reidentification on the bottom of this sheet (and presumably it was Linnaeus himself), he must have suffered a *lapsus calami*, for this specimen is so unlike any of the other sheets labelled "*viscosa*" that the identification appears absurd; 2) he was mistaken when he wrote "*dodecandra*" on sheet 850.14 which is clearly *C. viscosa*, and which in every respect matches the other *C. viscosa* sheets in the Linnaean Herbarium (e.g. 850.11, 850.13); 3) he was mistaken when he wrote "*dodecandra*" on sheet 850.7, which carries a good specimen of *C. serrata* Jacq. (*C. polygama* L.), only later to scratch this name out, and to substitute the correct name "*polygama*" after it; 4) lastly he made the curious error of misquoting the word *octandris* as *dodecandris* when copying the original definition (polynomial) of No. 242 from the *Flora Zeylanica* to the *Species Plantarum*, and then taking the specific epithet *dodecandris* from this miswritten adjective. It is an error easy to understand, however, for the young specimen (850.12) that he studied, as young specimens of that species are apt to, had 8 stamens, while no doubt on the somewhat older plants in his garden he observed the commoner higher stamen number, hence the later and very descriptive epithet "*dodecandra*."

SUMMARY

Cleome dodecandra L., though published in *Flora Zeylanica*, is based on cultivated American material grown in *Hortus Upsaliensis* by Linnaeus and now preserved in the Linnaean Herbarium. This material is conspecific with *Polanisia graveolens* Raf. The correct name of this taxon is, therefore, as was maintained earlier (Iltis 1954) on less certain evidence, *Polanisia dodecandra* (L.) DC., or, if retained in *Cleome*, *C. dodecandra* L.

POSTSCRIPT

THE SUBSPECIES OF POLANISIA DODECANDRA.

A reinterpretation of evidence presented earlier (Iltis 1958, esp. Figs. 6 and 9-21), and observations of some of these taxa in the field, demands that the Mexican and Southwestern *P. uniglandulosa* (Cav.) DC. should be considered a perfectly distinct species on morphological as well as geographic grounds, and not as a subspecies of *C. dodecandra*,[5] though the two are evidently closely related. On the other hand, *P. dodecandra* and the western *P. trachysperma* behave like geographical subspecies, the former evidently a taxon of more recent evolutionary origins, restricted to the glaciated northeastern United States and southern Quebec, but intergrading with the latter in a broad belt from Missouri to Minnesota. The species is therefore composed of *P. dodecandra* (L.) DC. ssp. *dodecandra* and *P.d.* ssp. **trachysperma** (T. & G.) Iltis **stat. nov.** (= *P. trachysperma* T. & G. Fl. N. Am. 1: 669. 1840).

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[5]I am obligated to Dr. W. L. Brown, Jr., Museum of Comparative Zoology, Harvard University, for calling some of the pertinent reasons for this interpretation to my attention.

POLANISIA DODECANDRA IN NEW HAMPSHIRE[1]

Polanisia dodecandra (L.) D. C. of the Capparaceae, not previously recorded in New Hampshire, has been found growing in Durham, New Hampshire. In New England, this species was reported only from the Lake Champlain region of Vermont by Bean, Hill, and Eaton (Rhodora, **63**:53, 1961). The records, however, are based essentially on specimens in the Harvard Herbaria. In Connecticut, Weatherby reported it from the banks of the Hockanum River in East Hartford, and Driggs, from the vicinity of the Connecticut River at Hartford. These reports are cited in *The Catalogue of Flowering Plants and Ferns of Connecticut*, State of Connecticut Geological and Natural History Survey, Bull. **14**:211, 1910. I have been unable to locate any specimens collected in Connecticut in the herbaria at the University of Vermont, University of Connecticut, Yale University, and the Connecticut Botanical Society.

I found the plants growing in crushed granitic rock of the B&M railroad bed about two hundred yards north of the old Durham depot, on September 4, 1965. The sandy soil beneath the rock was fairly moist despite a dry superficial appearance.

On September 23, 1965, Dr. A. R. Hodgdon, Mr. Wendell Berry, Jr., and I examined the station more closely and estimated that betwen two and three thousand plants were growing in an area about three hundred feet long and thirty feet wide. The plants ranged in height from less than an inch to two feet. The collections from this station have been deposited in the University of New Hampshire Herbarium and in the New England Botanical Club Herbarium at Harvard University, Cambridge, Massachusetts

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[1]I wish to acknowledge the assistance of the following: Mr. Frank Seymour, Mr. Leopold Charette, Dr. George Torrey and Dr. James Neale. Their help in my search for herbarium specimens is much appreciated.

CHROMOSOME NUMBERS IN VERNONIA (COMPOSITAE)

S. B. JONES, JR. AND W. H. DUNCAN

The genus *Vernonia* is a member of the tribe Vernonieae of the Compositae, which is not as well known cytologically as the other tribes in the family. It is the largest genus in the tribe with about 1000 species of temperate and tropical America, Asia and Africa. The members of the genus are herbs or shrubs, and nearly all are perennial. The North American species of *Vernonia* were monographed by Gleason (1906) who also treated them in "North American Flora" in 1922. Chromosome numbers reported in *Vernonia* are summarized in Table 1. This list includes both Old and New World species. Gametic numbers of 9, 10, 16, 17, 18, 20, and 27 are indicated. The first known determination was in 1933 by G. W. Bohn, who counted $n=18$ in *V. baldwinii* (personal communication to the senior author, April, 1962). Grant (1953) suggested that the basic number for the genus may be 9 based on his record for *V. cinerea*, a species considered by Gleason to be one of the more primitive *Vernonia*. Additional work is needed, however, to establish Grant's hypothesis firmly. Hunter (1964), in a recent paper, has presented chromosome counts of $n=17$ for seven species and one hybrid. In connection with taxonomic studies in the genus, the chromosome numbers were obtained for 13 taxa and these are reported in this paper. Meiotic chromosome counts were obtained from pollen mother cell squashes. Buds were collected in the field or from transplants, and killed and fixed in modified Carnoy's (4 parts chloroform: 3 parts absolute alcohol: 1 part glacial acetic acid). All material was squashed and stained in acetocarmine. Voucher specimens were made and deposited in the University of Georgia Herbarium. Camera lucida drawings and photomicrographs were used to record the observations which were made from fresh mounts.

All plants studied had a gametic number of $n=18$. Differences in chromosome size and morphology were not discernible. Meiotic figures appeared normal. This was true even in those individuals suspected of being of hybrid origin. Hunter (1964) reports a gametic number of $n=17$ or ca. 17 for three of the taxa reported in this paper. The reason for, or the significance of this variation is not known at this time. It is possible that both $n=17$ and $n=18$ exist within the populations and taxa of this genus.

Hybridization frequently occurs in *Vernonia* (Gleason, 1906) and those that we have studied are no exception. Hybridization studies by Jones (1964a) demonstrated that all combinations of taxa attempted were cross-fertile. Certainly chromosome number would not be a limiting factor preventing hybridization. The taxa are usually ecologically or geographically isolated; however, these external barriers are not completely effective, producing much of the variation we find in populations of *Vernonia*. Field cllected intermediates, as well as artificial F_1 hybrids, appear to undergo normal meiosis during pollen formation.

Since chromosome numbers are known for only about 30 of the possible 1000 species, it is obvious that additional cytotaxonomic work is needed in *Vernonia* before a realistic concept of cytological relationships in the genus may be established. Since the genus is widespread in temperate and tropical America, Asia, and Africa, geographic and taxonomic correlations of chromosome numbers might prove of interest.

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Table 1. Chromosome Numbers in *Vernonia* (Compositae).

Taxon	Chromosome Number	Author(s) or Vouchers[a]
V. acaulis (Walt.) Gleason	$n=17$	Hunter 1964
	$n=18$	*22394*, Duncan, Elbert Co., Ga.

[a]Vouchers collected by senior author unless otherwise noted.

V. angustifolia Michx.	*n*=ca.17, 17	Hunter 1964
V. angustifolia Michx. var. *angustifolia*	*n*=18	*1055*, McDuffie Co., Ga.; *1089*, Camden Co., Ga.; *1119*, Telfair Co., Ga.; *1112*, Lowndes Co., Ga.; *1116*, Coffee Co., Ga.; *1130*, Wilkinson Co., Ga.
V. angustifolia Michx. var. *mohrii* S. B. Jones	*n*=18	*1091*, *1092*, Duval Co., Fla.; *1059*, Bibb Co., Ala.; *1060*, *1061*, Autauga Co., Ala.; *1054*, Talbot Co., Ga.; *1096*, Putnam Co., Fla.; *1102*, Lake Co., Fla.; *1105*, Alachua Co., Fla.; *1111*, Lowndes Co., Ga.
V. angustifolia Michx. var. *scaberrima* (Nutt.) A. Gray	*n*=18	*1075*, Emanuel Co., Ga.; *1122*, Hancock Co., Ga; *1420*, D. J. Banks, Claredon Co., S. C. *2595*, Perry Co., Ala.
V. altissima Nutt.	*n*=18	Prameshwar 1960[b]
V. anthelmintica (L.) Willd.	*n*=27	Bohn 1933
V. baldwinii Torr.	*n*=18	*1099*, *1100*, Charlotte Co., Fla.
V. blodgettii Small	*n*=18	Mangenot et al. 1957[b]; Miege 1960[b]; Grant 1953
V. cinerea (L.) Less.	2*n*=18	Mangenot et al. 1957[b]
V. X concinna Gleason (pro sp.)	*n*=18	*1093*, Putnam Co., Fla.; *1104*, Lake Co., Fla.
V. colorata Drake	2*n*=18	Mangenot 1957[b]
V. conferta Benth.	2*n*=18	*1063*, Lee Co., Ala.; *1066*, Harris Co., Ga.
V. X *dissimilis* Gleason (pro sp.)	*n*=18	Riley and Hoff 1961[b]
V. glabra Vatke	2*n*=20	Hunter 1964
V. greggii Gray	*n*=17	Hunter 1964
V. guadalupensis Heller	*n*=17	Mangenot 1958[b]
V. guineensis Benth.	2*n*=20	Hunter 1964
V. interior Small	*n*=ca.17, 17	Turner et al. 1962[b]
V. karvinskiana DC.	*n*=ca.17	Miege 1960[b]
V. kotschiana Sch. Bip.	2*n*=18	Hunter 1964
V. lindheimeri Gray	*n*=ca.17, 17	Hunter 1964
V. marginata (Torr.) Raf.	*n*=17	

[b]Cited in "Index to Plant Chromosome Numbers," M. S. Cave, Editor.

V. noveboracensis (L.) Michx.	*n*=18	*2604*, Gwinett Co., Ga.
V. nudiflora Less.	*n*=16	Covas and Hunziker 1954[b]
V. ovalifolia T. & G.	*n*=18	*1095*, Putnam Co., Fla.; *1104*, Lake Co., Fla.
V. perottetii Sch. Bip.	2*n*=18	Miege 1960[b]
V. platensis Les.	*n*=20	Cabrera 1944
V. primulina O. Hoffm.	*n*=20	Mangenot et al. 1958[b]
V. pulchella Small	n=18	*1084*, Tattnal Co., Ga.; *1085*, Long Co., Ga.
V. X *recurva Gleason* (pro sp.)	*n*=18	*1077*, Emanuel Co., Ga.; *1083*, Tattnal Co., Ga.
V. texana (A. Gray) Small	*n*=17	Hunter 1964
	n=18	*2292*, Franklin Co., Miss.; *2293*, Amite Co., Miss.

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NATURAL HYBRIDS OF LADY'S SLIPPERS (CYPRIPEDIUM) IN MANITOBA

H. H. MARSHALL, A. T. H. GROSS AND G. A. STEVENSON

A small yellow lady's slipper, *Cypripedium Calceolus* L. var. *parviflorum* (Sal.) Fern., occurs frequently in low meadows in southern Manitoba, Canada, while *C. candidum* Muhl., a tiny white lady's slipper, is more restricted and has been reported from only three Manitoba locations, Woodlands, Brandon and Aweme (Scoggan, 1947). In 1954 an investigation of cream colored lady's slippers found in association with *C. Calceolus* var. *parviflorum* and *C. candidum*, was conducted by the authors. From 1954 to 1964 annual surveys of three areas of 5 to 20 acres between Brandon and Aweme revealed similar lady's slippers but profuse flowering was recorded only in 1954. These hybrids were similar to those described by Fuller (1932) and Curtis (1932) as *C.* × *Andrewsii* Fuller.

Seedlings of *C. Calceolus* var. *parviflorum* are influenced greatly by local environmental conditions (Curtis, 1943). He reported that plants grown from seed may bloom in 9 years under favorable conditions but may take 15 years to bloom and *C. candidum* probably requires 12 or more years to bloom. Plants of both species are long-lived.

Lady's slippers in nature are pollinated by bees of the genus *Andrena* (Darwin 1890). The sticky pollen does not permit wind pollination and the location of anthers and stigma precludes self pollination. Hybrid lady's slippers can therefore occur naturally if suitable pollinators are present and cross-compatible species occur in the same area and have overlapping periods of bloom. Fuller (1932) states that it is very likely wherever *C. candidum* and *C. Calceolus* var. *parviflorum* grow in the same vicinity, hybrids will be found.

Stebbins (1957) describes a method of indexing plant characteristics to identify hybrid populations. Each trait

is indexed on a scale of from 1 to 5 although the range may be either reduced or extended. Plants with the lowest total for indexed characteristics are considered of the one parental type and those with the highest total for indexed characteristics are of the other parental type.

This paper reports characteristics of natural hybrids of *C. candidum* × *C. Calceolus* var. *parviflorum* in Manitoba and presents an hypothesis to explain the origin of the hybrids.

In June 1954, 55 specimens of *Cypripedium* were collected from a low lying meadow in section 11 township 10 range 18 west of the principal meridian southeast of Brandon, Manitoba. Measurements or descriptions of 10 characteristics,, i.e. height, leaf number, length and width of the largest leaf, length and width of lateral petals, color and length of lip, and length and width of the upper sepal, were recorded. Plant characteristics were indexed according to the method described by Stebbins (1957) to identify hybrid populations. The smallest measurement, fewest number and least intensity of color was assigned the lowest index number. The specimen plants with the lowest total for indexed characteristics are most similar to the *C. candidum* parent and those with the highest totals are most similar to the *C. Calceolus* var. *parviflorum* parent.

In 1963, controlled crosses were made between *C. candidum* and *C. Calceolus* var. *parviflorum* to establish whether the purported parents were cross-compatible and could give rise to hybrids.

Viable hybrid seed was readily produced by hand pollination of *C. candidum* and *C. Calceolus* var. *parviflorum* thus indicating that they are cross-compatible and could have given rise to hybrids. Native *C. candidum* commences bloom two weeks earlier than *C. Calceolus* var. *parviflorum* at Brandon, Manitoba, hence, their bloom periods seldom coincide and rarely overlap for more than a few days. This is at variance with Fuller (1932) who stated that they bloom at the same time. The bloom period of *C.* × *Andrewsii* commences 10 days after *C. candidum*, thus it overlaps the bloom period of *C. Calceolus* var. *parviflorum* to a greater

Table 1. Plant measurements (cm) of the two parental species, *C. candidum* and *C. Calceolus* var. *parviflorum*.

Plant Characteristic	*C. candidum* 1.	*C. candidum* 2.	*C. Calceolus* var. *parviflorum* 1.	*C. Calceolus* var. *parviflorum* 2.
Plant height	15 - 40	14 - 22	20 - 70	17.2 - 32.5
Leaf-length	-	9.5 - 12.5	11 - 20	12 - 15.5
-width	1 - 4	2.0 - 3.5	4 - 12	3.8 - 6.7
Sepal-length	2 - 3	2.1 - 2.8	4 - 7	3.8 - 4.8
-color	greenish spotted with purple	green with purple streaks	greenish yellow streaked purple	greenish yellow streaked purple
Petal-length	2.5 - 3.5	2.2 - 3.2	5 - 9	4.8 - 6.1
-color	greenish spotted with purple	green with purple streaks		
Lip-length	1.8 - 2.5	1.6 - 2.0	3 - 5	2.9 - 3.5
-color	waxy white, purple veined	white, purple veins	golden yellow	yellow

1. Data taken from Scoggan (1957) and Fernald (1950.
2. Brandon data.

extent than that of *C. candidum*. Bloom appears to be influenced greatly by local environmental conditions as indicated by Curtis (1943). Only in 1954 was profuse flowering observed. In 1964 late spring frosts on May 30 (25°F), May 21 (27°F) and June 1 (26°F) destroyed flower buds and bloom was observed in only the most sheltered places. Spring frosts of 27°F or lower were recorded after May 20 in 1958, 1959, 1961, and 1963 which could account for the restricted amount of flowering observed in those years.

Measurements of *C. candidum* and *C. Calceolus* var. *parviflorum* (author's collection No.'s 884 and 883) are similar to those published by Scoggan (1957) and Fernald (1950). The *C. candidum* plants were smaller than the *C. Calceolus* var. *parviflorum* specimens in all 6 of the measurements recorded (Table 1).

Indices for the naturally occurring Cypripedia indicated 8 plants resembled *C. candidum*, 8 resembled *C. Calceolus* var. *parviflorum* and 39 were intermediate between these two species and resembled *C.* × *Andrewsii* (Table 2). This classification was corroborated by the identifications reported by Boivin (1960). The index totals for the 8 *C. candidum* plants ranged from 10 to 14 and did not overlap with the 39 *C.* × *Andrewsii* specimens which ranged from 19 to 38. The 8 *C. Calceolus* var. *parviflorum* specimens index totals ranging from 30-47 formed a continuous series with *C.* × *Andrewsii*.

The parental species were not readily distinguishable on the basis of leaf number and width of lateral petals, hence, these two characteristics were of no value in indexing the specimens. Lip color of the hybrids ranged from white of the *C. candidum* parent to yellow of the *C. Calceolus* var. *parviflorum* parent with many creamy intermediate types. The seven other plant characteristics revealed a complete overlap of the parental species by the hybrids. The hybrids were readily separated from the *C. candidum* plants using either the indexing method of Stebbins (1957) or the standard taxonomic bases of specimen identification, but they were less readily distinguished from the *C. Calceolus* var.

parviflorum parent. This is in agreement with Stebbins (1957) that hybrids tend to resemble one parent more than another.

It is postulated that the hybrids are of relatively recent origin. The largest plants are the parental types and the hybrids are either single stemmed or small clumps. The slow growth and infrequency of bloom of Cypripedia indicates that the hybrid swarms could have developed since 1900. This would explain why J. H. Macoun and H. Criddle (Scoggan 1947), who observed the parental species in the Brandon — Aweme district did not report hybrid swarms of creamy colored *Cypripedium*.

These hybrid swarms probably developed as a result of a change in the environment in which the parent species grew. Hybrid swarms usually appear in a disturbed habitat but this is not possible with Cypripedia as they are never found in cultivated land, rarely in pastured areas, and are confined to areas that have been undisturbed. It is suggested

Table 2. Frequency of plant measurements of *C. candidum*, *C. Calceolus* var. *parviflorum* and *C.* × *Andrewsii* indexed according to Stebbins (1957).

	C. candidum			*C.* × *Andrewsii*					*C. Calceolus var. parviflorum*				
Index No.	1	2	3	1	2	3	4	5	1	2	3	4	5
Plant characteristic	frequency			frequency					frequency				
Plant height	5	3	0	5	8	12	9	5	0	0	1	3	4
Largest leaf-length	5	2	1	8	9	8	7	7	0	0	2	2	4
-width	7	0	1	6	8	7	13	5	0	0	0	3	5
No. of leaves[1].	3	5	0	7	27	5	—	—	0	6	2	—	—
Upper sepal-length	7	1	0	3	11	10	8	7	0	0	0	3	5
-width	8	0	0	6	6	14	10	3	0	0	0	2	6
Lateral petals-length	7	1	0	2	13	14	6	4	0	0	0	1	7
-width[2]	3	5	0	5	17	16	1	—	2	0	2	4	—
Lip-length	8	0	0	3	12	7	8	9	0	0	0	3	5
-color	8	0	0	3	6	9	3	18	0	0	0	0	8
Range of totals	10 to 14			19 to 38					39 to 47				
Plant average	12.6			29.1					42.4				

[1]Indexed on a 1 to 3 scale.
[2]Indexed on a 1 to 4 scale.

that although native *Andrena* bees were the probable natural pollinators, the introduction of the honeybee made the hybrid swarm possible. The introduction of honeybees in the early 1900's coincides with the estimated time when the hybrids originated and they could have been the insect vector which brought about the development of hybrids.

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EXPERIMENTAL FARM, BRANDON, MANITOBA

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A STUDY OF VARIATION IN THE CYTOTYPES OF DRYOPTERIS SPINULOSA.

ROLLA TRYON[1] AND DONALD M. BRITTON[2]

Among the groups of ferns in which cytological and evolutionary studies are being pursued most vigorously is the genus *Dryopteris* (*sens. strict.*) of North America and Europe. In eastern North America (see Bibliography) thirteen fertile cytotypes have been recognized, and among these six are diploid (n=41), six are tetraploid and one is hexaploid. Sixteen sterile hybrids of these fertile cytotypes have been examined cytologically and four of them are diploid, nine are triploid, two are tetraploid and one is pentaploid. These previous studies have been concentrated on chromosome counts of the taxa and hybrids to determine the level of ploidy and on chromosome pairing analyses of natural and synthetic hybrids as evidence of their genome relations. There have been no extensive cytological surveys of any of the cytotypes nor analyses of their variation. It was against this background, and our belief that cytological data can be fully exploited in evolutionary studies only when accompanied by data on morphological variation, that the present work was initiated. The data that we have obtained on variation of the cytotypes of *Dryopteris spinulosa* is pertinent to the problem of the origin of the tetraploid var. *spinulosa* and to the problems of the evolutionary potential of triploids and the variation of derived hexaploids.

Dryopteris spinulosa var. *intermedia* (2 X) and var. *spinulosa* (4 X) were chosen as especially suitable taxa for investigation because of their abundance and because of the abundance of their sterile triploid hybrid. These taxa presented an opportunity to study and compare variation, in a related diploid and tetraploid and their hybrid, on a broad

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[1]Gray Herbarium, Harvard University.
[2]Department of Botany, University of Guelph. This study was supported, in part, by grants from Sigma Xi-RESA to D. M. Britton.

basis. *Dryopteris spinulosa* is a rather common species in northeastern United States and adjacent Canada where it usually grows on wooded hillsides, or in wooded swamps and less often in shrubby swamps, or along damp roadsides. Variety *spinulosa* (figs. 9, 10) grows more commonly in wet, often water-logged sites, while var. *intermedia* (figs. 5,

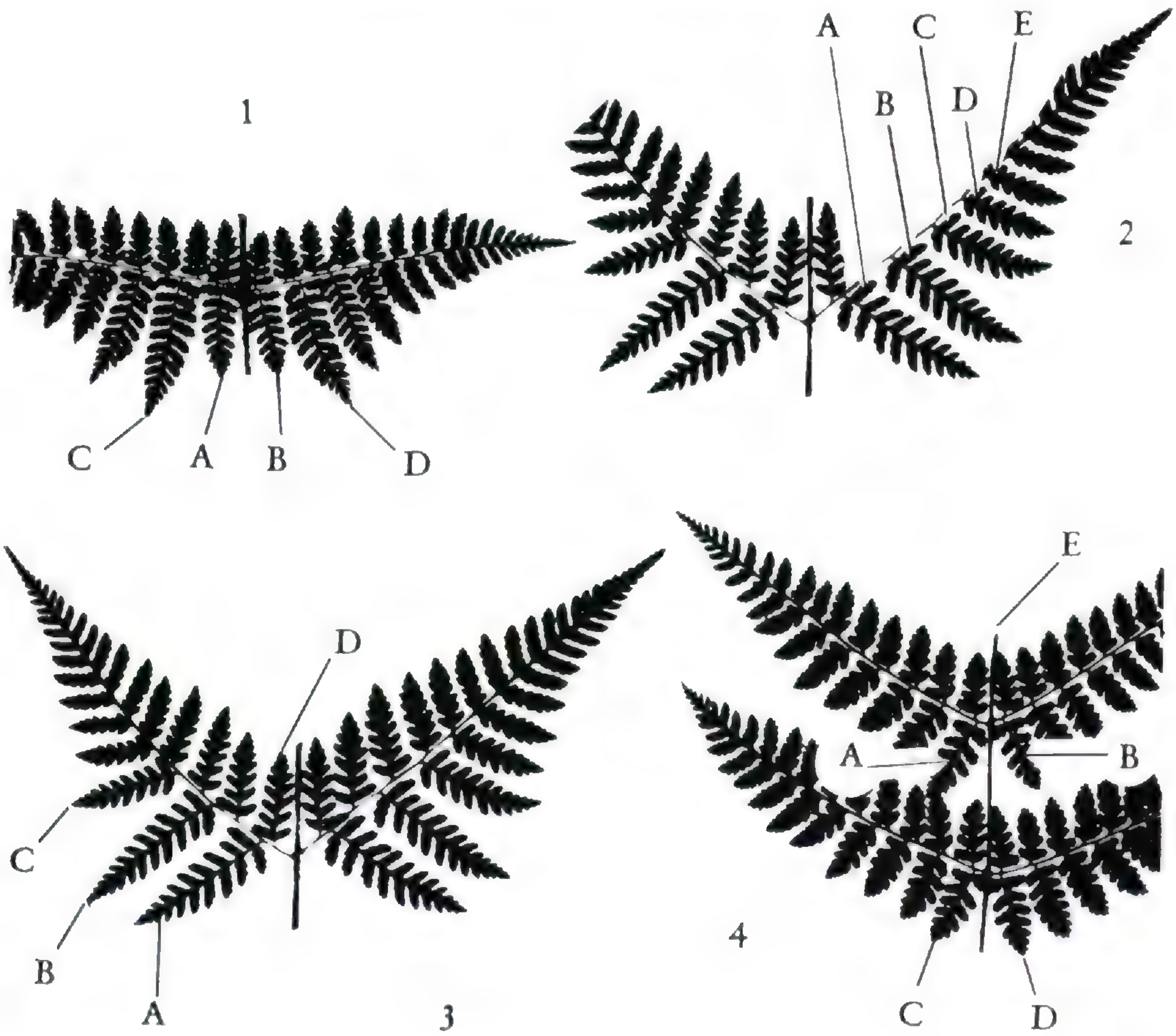


PLATE 1320

Figs. 1-4. Illustrations of characters *c* to *f*. Fig. 1 — character *c*, basal pinnae of *intermedia*, each inferior basal pinnule, A and B, is shorter than the adjacent one, C and D. Fig. 2 — character *d*, basal pinnae of the *hybrid*, five basal tertiary segments, A to E, on the acroscopic side of the inferior pinnules, are parallel to the pinna-rachis. Fig. 3 — character *e*, basal pinnae of the *hybrid*, three of the inferior pinnules, A to C, are longer than the basal superior pinnule, D. Fig. 4 — character *f*, central pinnae of *intermedia*, on each of the four pinnae, the basal inferior pinnule, A to D, overlies the rachis, E.

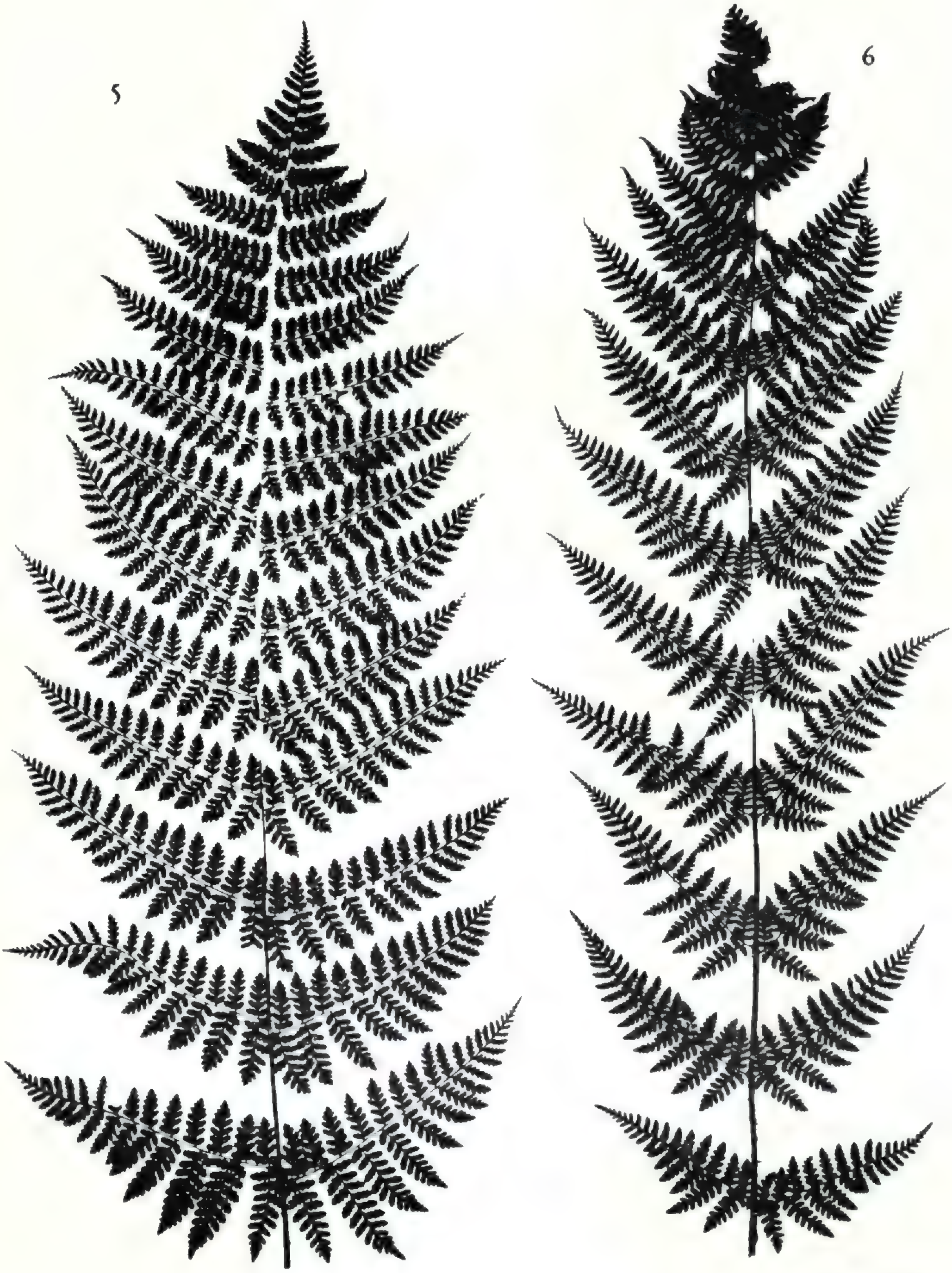


PLATE 1321

Figs. 5-6. Lamina of *Dryopteris spinulosa* var. *intermedia*, diploid, × ¼. Fig. 5 — from Plant 110. Fig. 6 — from Plant 357.

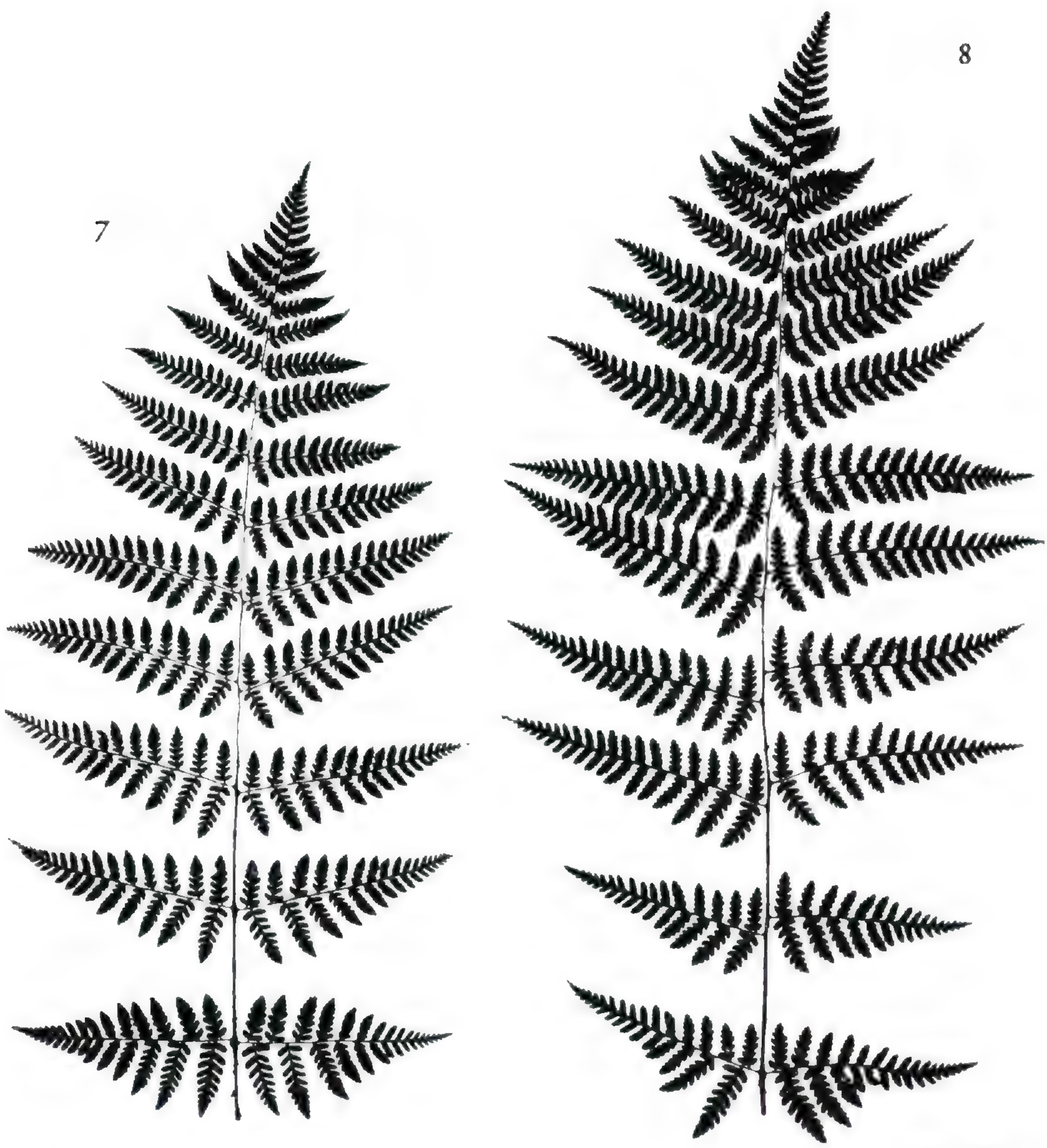


PLATE 1322

Figs. 7-8. Lamina of *Dryopteris spinulosa* var. *intermedia* × var. *spinulosa*, triploid, × ¼. Fig. 7 — from Plant 487. Fig. 8 — from Plant 268.

6) is most often in moist but well drained sites, but both exhibit considerable latitude in their habitat. The two varieties frequently grow intermixed or in close proximity to each other. In our experience, their hybrid (figs. 7,8) is found whenever the two parents are in some abundance (and sometimes when one is rare) and it is usually frequent or even more abundant than either parent.

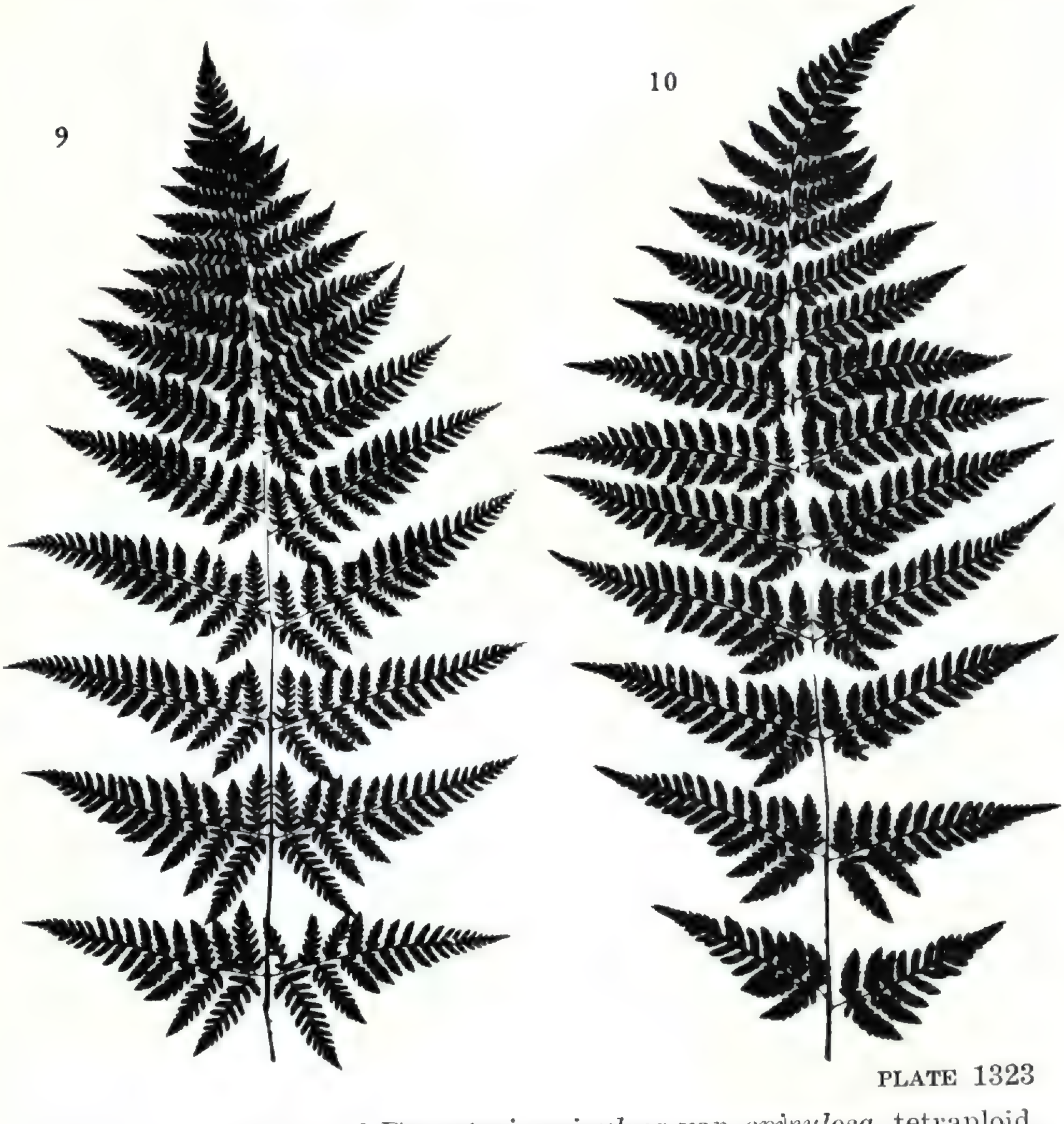


PLATE 1323

Figs. 9-10. Lamina of *Dryopteris spinulosa* var. *spinulosa*, tetraploid, × ¼. Fig. 9 — from Plant 272. Fig. 10 — from Plant 294.

The classification and nomenclature of this group is subject to considerable uncertainty and disagreement. While this paper does not intend to deal with either of these matters in a definitive manner, we do present some reasons later for the classification adopted. It is well established that var. *spinulosa* and var. *intermedia* are taxa (major evolutionary units) and disagreements about their taxonomic rank is of secondary importance. Some of the difficulties involved in the correct nomenclature are so involved and technical that we wish to do no more than mention their

existence. The following synonymy will serve to orient the reader with other names currently used for these plants.

Dryopteris spinulosa (O. F. Muell.) Watt, var. **spinulosa** (*Dryopteris spinulosa*; *Dryopteris spinulosa*, "typical"; *Dryopteris austriaca* (Jacq.) Woynar, var. *spinulosa* (Muell.) Fiori). In the remainder of the paper this will be referred to as *spinulosa*.

Dryopteris spinulosa var. **intermedia** (Willd.) Underw. (*Dryopteris intermedia* (Willd.) A. Gray; *Dryopteris austriaca* var. *intermedia* (Willd.) Morton). In the remainder of the paper this will be referred to as *intermedia*.

Dryopteris spinulosa var. **intermedia** × var. **spinulosa** (*Dryopteris intermedia* × *spinulosa*; *Dryopteris spinulosa* var. *fructuosa* (Gilbert) Trudell; *Dryopteris austriaca* var. *fructuosa* (Gilbert) Morton; *Dryopteris* × *triploidea* Wherry). In the remainder of the paper this will be referred to as the *hybrid*.

This study was initiated in 1959 and has continued through June of 1965. Rolla Tryon has made the analyses of the characters, Donald M. Britton the cytological determinations and the collections of specimens; both have contributed to the discussions and conclusions.

MATERIALS AND METHODS OF STUDY.

Most of the plants used in this study (155) were obtained from southern Ontario (west of 79° W. Long. and south of 46° N. Lat.). Twenty-five others were from the Algoma District of Ontario (east of Lake Superior) and eight were from Pennsylvania and Virginia. The material for cytological study was usually collected in late May to the middle of June. At that time a voucher leaf was taken from the plant and prepared as an herbarium specimen. In many cases, the plant also was marked with the collection number and additional leaves were collected from some of these plants in September of the same year and also in the following year. Individual plants, therefore, have been represented by one to sixteen leaves and often by sets of leaves collected in successive years. Eighty-nine plants of *intermedia* were determined as diploid ($n=41$); forty-seven plants of the *hybrid* were determined as triploid ($n=123$); and fifty-two plants of *spinulosa* were determined as tetraploid ($n=82$). Voucher specimens of these cytologically

determined plants have been deposited in the Herbarium, Department of Botany, University of Guelph and a selection of them in the Gray Herbarium, Harvard University.

Not all of the 188 plants and 746 leaves available have been used in this study. Some leaves were defective and others were too small (less than 25 cm. long) to be included in case they would bias the results. About 175 plants and 550 leaves were available for most characters; the number studied for each is given as part of Charts 1 and 2.

Thirty-four characters were considered during the course of our work. Eleven of these were studied in some detail and the results of these analyses are presented. Preliminary studies were made of eighteen other characters but these were not continued because the characters were either too variable to be of particular value or because no significant differences between *spinulosa* and *intermedia* were observed. Among these, a few of the variable characters were the following: complexity of the lamina, shape of the pinnae, tapering of the apex of the pinnae and size of the indusium. The variation of four other characters was not analysed principally because of technical difficulties in their study. An initial survey of these indicated that they probably behaved in the same manner as some of the characters analyzed in detail. These characters were the orientation of the rhizome, the color of the petiole scales, the evergreen quality of the leaves and the kind of habitat. Finally, the apex of the spines of the spores was not studied simply because of the small size of the character, the spines themselves being only about 1 micron long.

The illustrations have been prepared from a selection of specimens of the cytologically determined plants. These specimens were photographed and the negative printed as a silhouette. The specimens were relaxed in warm water, prior to photographing, so that they were substantially restored to their fresh condition. This is of some importance because minor shrinking, wrinkling and curling of the teeth and ultimate lobes can alter the total aspect of a pinna or lamina to a considerable degree.

ANALYSIS OF CHARACTERS.

The following comments on the individual characters explain the character, when necessary, and the manner in which it was studied. The original measurements or counts for six of the characters are presented in Charts 1 and 2 and in Graph 1. In order to compare the range of variation of the different characters and their means, this data was adjusted to a scale of 0 to 100 for each character (the minimum count or measurement=0, the maximum=100). For example, character *e* varies from a minimum count of 1 to a maximum of 8. Then 1=0 and 8=100 and counts of 2 to 7=14, 28, 43, etc., respectively. For characters *b* and *c* the score was then reversed (0=100, 100=0) so that the scores for all of the characters would be high for *intermedia* and low for *spinulosa*. These adjusted scores are presented in Chart 3 and in Graph 2. Selections of the data are presented in Charts 4 and 5 and in Graph 3 to illustrate special features of the variation of the cytotypes.

a. Glandularity of the base of the pinna.

The lamina of *intermedia* is glandular while that of *spinulosa* is usually glabrous. The glands are small, stalked and have a more or less spherical cap cell. They are usually most abundant at the base of the pinnae. There is some tendency for them to be deciduous as the leaf ages, although they will persist on leaves that have lived over the winter. In order to obtain a measurement of this character, the cytological voucher leaves (collected in early summer) were used and a single central pinna was chosen for observation. The glands that could be seen on the lower surface on one linear millimeter of the pinna stalk were counted. The data obtained from sixty plants are presented in Chart 1.

b. Length of the guard cells of the stomata.

This character was studied only in a preliminary manner although the results indicate that extended data would be of much interest. A portion of a leaf collected in late summer was relaxed in warm water and then placed in a lactic acid mount. Measurements were made, in micra, of the maxi-

mum length of the guard cells from stomata between the veins on the lower surface and the mean from ten measurements was obtained for each leaf. The data obtained from 27 plants are presented in Chart 1.

c. Length of the inferior basal pinnules on the basal pinnae in relation to the adjacent ones.

Each basal pinna of *intermedia* usually has the inferior basal pinnule shorter than the adjacent one (fig. 1), while *spinulosa* usually has the inferior basal pinnule longer than the adjacent one (fig. 16).

CHART 1. Analysis of variation in *Dryopteris spinulosa*, original counts and measurements of characters *a* and *b*. (See Graph 1.)

	Range of variation of all leaves. (Total number of leaves.)	Mean of all leaves.
a. Glandularity of the base of the pinna: number of glands on one linear mm. of pinna-stalk, each leaf from a different plant.		
intermedia	10-75 (20)	45.6
hybrid	9-55 (20)	29.2
spinulosa	0-9 (20)	1.6
b. Length of the guard cells of the stomata: mean of ten measurements for each leaf, each leaf from a different plant.		
intermedia	34-53 micra (9)	42.5 micra
hybrid	40-58 micra (9)	49.5 micra
spinulosa	44-68 micra (9)	55.7 micra

The character was measured by taking the average of the length of both basal pinnules and both adjacent ones because the relative length of these two pinnules may differ on each basal pinna. The measurements are in millimeters and the average is expressed as the basal pinnules being longer, or shorter, than the adjacent ones. The data obtained from 546 leaves are presented in Chart 2; illustrations of the variation are given in figs. 11-16.

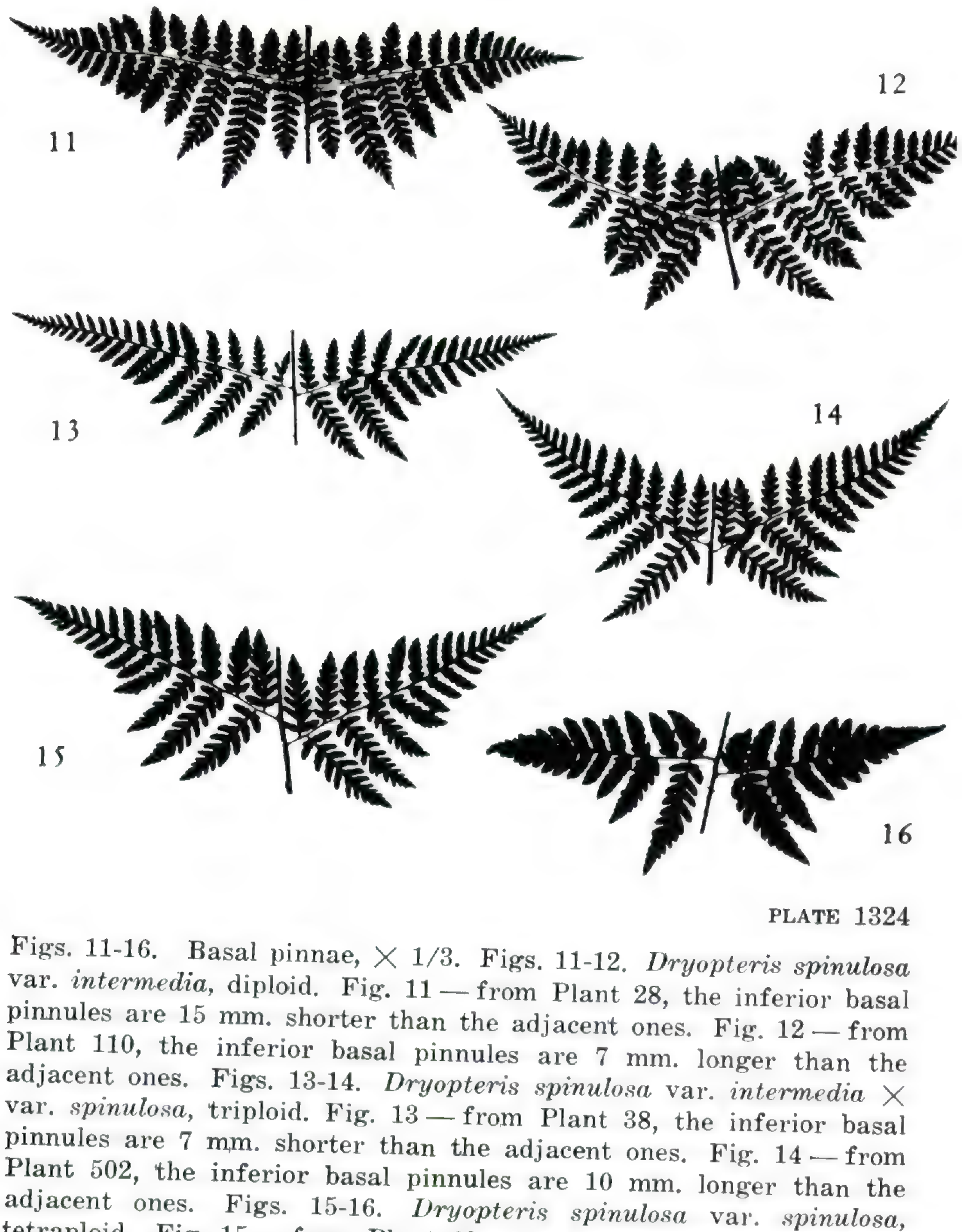


PLATE 1324

Figs. 11-16. Basal pinnae, × 1/3. Figs. 11-12. *Dryopteris spinulosa* var. *intermedia*, diploid. Fig. 11 — from Plant 28, the inferior basal pinnules are 15 mm. shorter than the adjacent ones. Fig. 12 — from Plant 110, the inferior basal pinnules are 7 mm. longer than the adjacent ones. Figs. 13-14. *Dryopteris spinulosa* var. *intermedia* × var. *spinulosa*, triploid. Fig. 13 — from Plant 38, the inferior basal pinnules are 7 mm. shorter than the adjacent ones. Fig. 14 — from Plant 502, the inferior basal pinnules are 10 mm. longer than the adjacent ones. Figs. 15-16. *Dryopteris spinulosa* var. *spinulosa*, tetraploid. Fig. 15 — from Plant 68, the inferior basal pinnules are equal in length to the adjacent one. Fig. 16 — from Plant 36, the inferior basal pinnules are 15 mm. longer than the adjacent ones.

d. Number of parallel tertiary segments.

In *intermedia* there is a strong tendency to have many of the basal tertiary segments, on the acroscopic side of

the pinnules, disposed more or less parallel to the pinna-rachis. This character is illustrated (by the *hybrid*) in fig. 2. In *spinulosa* (fig. 15) there is a strong tendency to have rather few such segments parallel to the pinna rachis. This character has been counted on one arbitrarily chosen basal pinna and on the pinnules on its inferior side, as illustrated in fig. 2. The data obtained from 565 leaves are presented in Chart 2.

This character may be correlated with the size of the pinna and for this reason small leaves were not used in its study. In leaves of moderate or large size there is no absolute correlation with the size of the pinna as the following counts will show. In a plant of *spinulosa*, a basal pinna of one leaf was 9.5 cm. long and had 1 parallel tertiary segment on its inferior side. A basal pinna, from another leaf of the same plant, was 8 cm. long and had 2 parallel tertiary segments on its inferior side.

e. Number of longer inferior pinnules.

The pinnae in *spinulosa* tend to be relatively broad at the base and to be abruptly reduced in width. In *intermedia* there is a tendency for the pinnae to be hardly, or not at all, broadest at the base and to be gradually reduced in width. These tendencies have been reduced to an easily observed character by using one basal pinna and comparing the length of the inferior pinnules with the basal superior one. The character was taken from the basal pinna with the shortest basal superior pinnule and, in reference to this pinnule, the number of inferior pinnules that were longer was determined. The data obtained from 546 leaves are presented in Chart 2; and the character is illustrated (by the *hybrid*) in fig. 3.

As in the study of the previous character, small leaves were not used because of the possibility that small pinnae would bias the data. In leaves of moderate to large size, there is no absolute correlation with the size of the pinna as the following counts will show. A basal pinna of one leaf of a plant of *intermedia* was 11.5 cm. long and had 5

longer inferior pinnules. A basal pinna from another leaf of the same plant was 10 cm. long and had 6 longer inferior pinnules.

CHART 2. Analysis of variation in *Dryopteris spinulosa*, original counts and measurements of characters *c* to *f*. (See Graph 1.)

	Range of variation		Mean of all leaves.
	All leaves. (Total number of leaves.)	Plant means from plants with 4 or more leaves. (Total number of plants: total number of leaves.)	
c. Length of the inferior basal pinnules of the basal pinnae in relation to the adjacent ones.			
intermedia	16 mm. shorter to 7 mm. longer. (255)	10 mm. shorter to 2 mm. longer. (31: 172)	4.5 mm. shorter
hybrid	7 mm. shorter to 11 mm. longer. (119)	1.5 mm. shorter to 5 mm. longer. (16: 87)	1.7 mm. longer
spinulosa	equal to 16 mm. longer. (108)	3.7 mm. longer to 9 mm. longer (11:60)	6.4 mm. longer
d. Number of parallel tertiary segments.			
intermedia	3-10 (296)	4.0-6.8 (19: 107)	5.7
hybrid	1-8 (137)	2.5-4.7 (18: 95)	3.4
spinulosa	1-5 (132)	1.6-3.5 (14: 82)	2.5
e. Number of longer inferior pinnules.			
intermedia	2-8 (278)	3.4-6.2 (34: 212)	4.8
hybrid	2-5 (135)	2.0-3.6 (17: 96)	2.9
spinulosa	1-4 (133)	2.0-3.1 (14: 84)	2.1
f. Number of pinnules that overlie the rachis.			
intermedia	0-10 (299)	1*-2.9-10 (30: 162)	7.8
hybrid	0-7 (155)	0-3.0 (20: 107)	1.0
spinulosa	0-3 (138)	0-0.75 (17: 97)	0.07

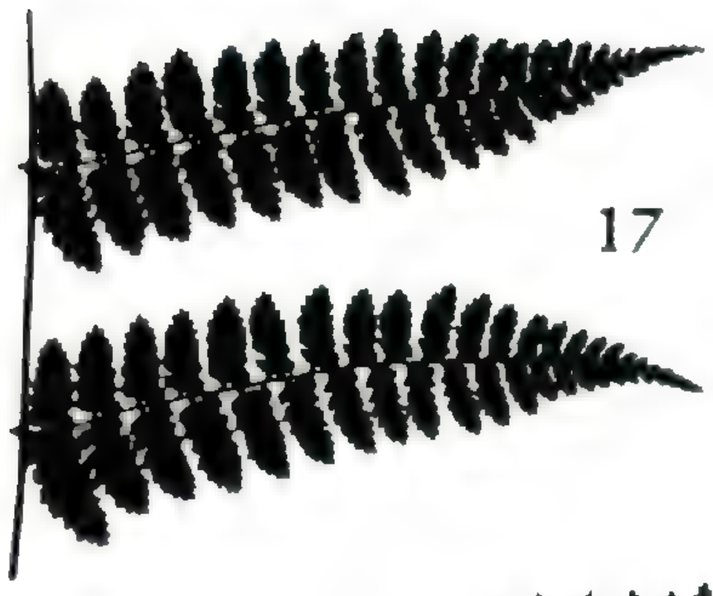
*Plant 357 with two leaves.

f. Number of pinnules that overlie the rachis.

In *intermedia*, the pinna, the basal inferior pinnule and its basal segment nearest the rachis are disposed so that the basal segment is relatively close to the rachis and most often so that it overlies it (figs. 4 and 5.). In *spinulosa* these same structures are disposed so that the basal segment is relatively far from the rachis (figs. 9 and 10). This character was analyzed by the number of basal inferior pinnules that overlie the rachis on the lowest ten pinnae. Fig. 5 shows a lamina with 10 overlying pinnules and figs. 9 and 10 show laminae with no overlying pinnules. Only 10 pinnae were used in order to avoid bias due to high counts in unusually large leaves. Bias due to low counts in small leaves was eliminated (or reduced) by taking only those leaves with a lamina at least 30 cm. long. In order to confirm that this character was not related to changes in orientation due to pressing of the leaf, counts were made on the same leaves when they were fresh and after they were pressed. No difference was observed. The data obtained from 592 leaves are presented in Chart 2.

g. Position of the pinnae in relation to the rachis.

The pinnae may be patent (more or less at right angles to the rachis) or they may vary to ascending (at an acute angle to the rachis). This character was originally studied because it has been one that has been prominently used for the identity of the taxa, and especially of the *hybrid*. However, so much variation was soon observed in both *intermedia* and *spinulosa* that the character was neither studied further nor refined. Figures 17 and 18 of *intermedia* and figs. 31 and 32 of *spinulosa* illustrate some of the variation observed in the pinna-angle. Ninety-seven leaves of *intermedia* had patent pinnae, 55 leaves had them slightly ascending and 23 had them definitely ascending. The same range of variation, but in somewhat different proportions, was seen in *spinulosa* in which 13 leaves had patent pinnae, 47 leaves had slightly ascending pinnae and 23 leaves had definitely ascending pinnae. The character was also studied on plants from which several leaves were available but these



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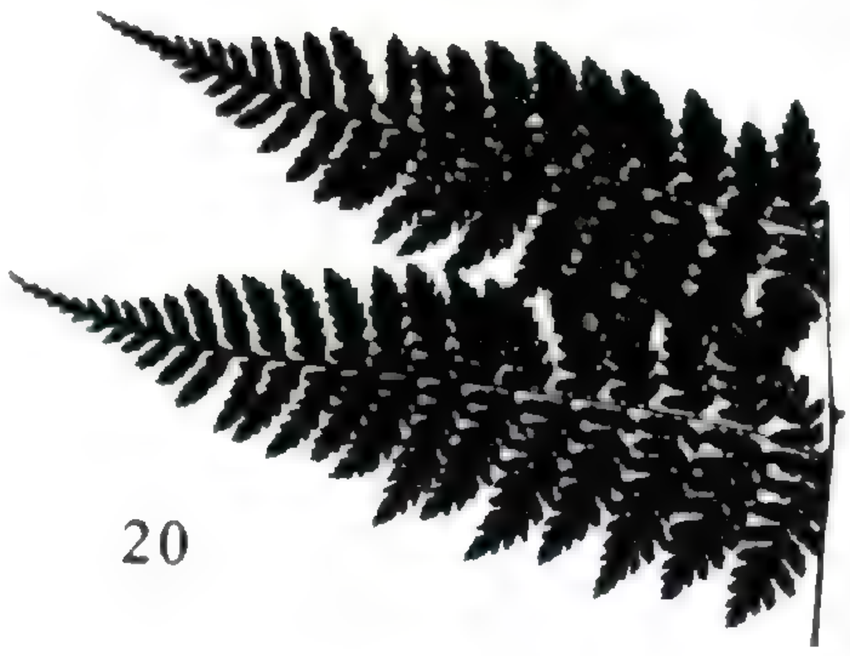

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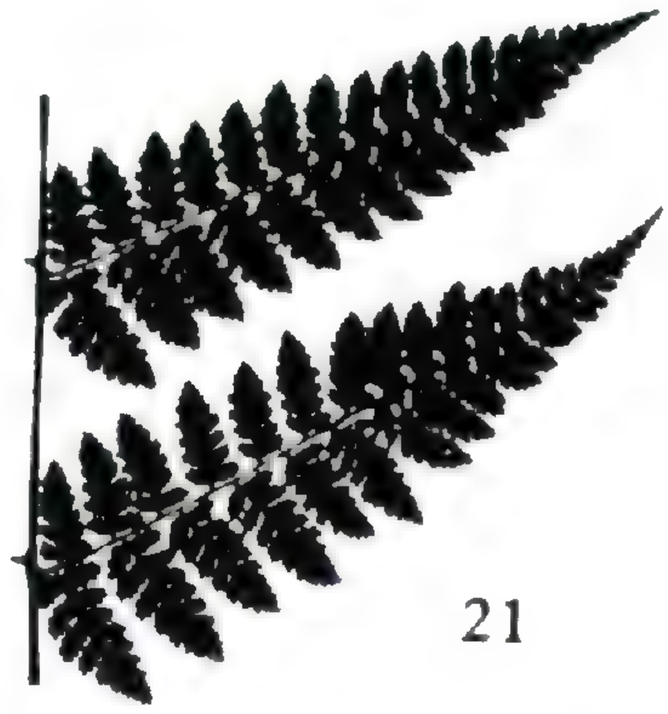

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PLATE 1325

Figs. 17-23. Central pinnae of *Dryopteris spinulosa* var. *intermedia*, diploid, × 1/3. Fig. 17 — from Plant 105. Fig. 18 — from Plant 357. Fig. 19 — from Plant 335. Fig. 20 — from Plant 108. Fig. 21 — from Plant 29. Fig. 22 — from Plant 104. Fig. 23 — from Plant 111.

results confirmed the previous data, i.e., although there was a slight statistical difference between *intermedia* and *spinulosa* it was not a sufficient one to invite further analysis.

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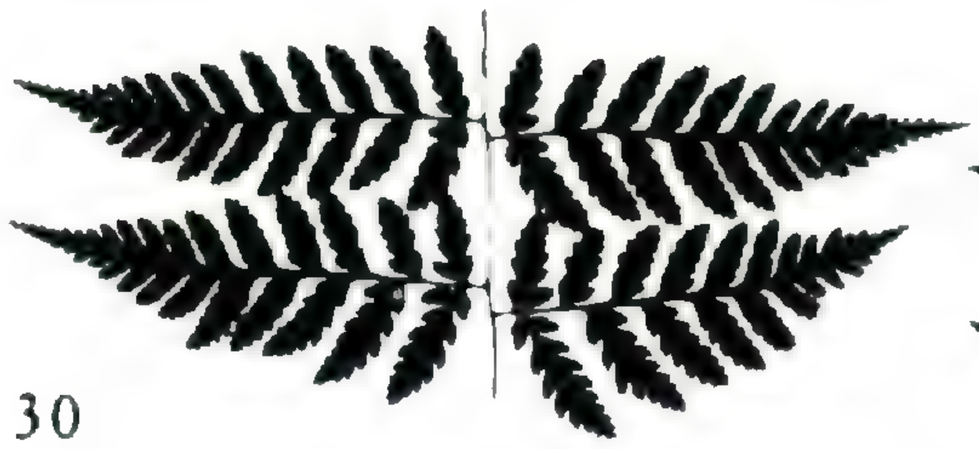
PLATE 1326

Figs. 24-29. Central pinnae of *Dryopteris spinulosa* var. *intermedia* × var. *spinulosa*, triploid, × 1/3. Fig. 24 — from Plant 86. Fig. 25 — from Plant 84. Fig. 26 — from Plant 562. Fig. 27 — from Plant 87. Fig. 28 — from Plant 338. Fig. 29 — from Plant 32.



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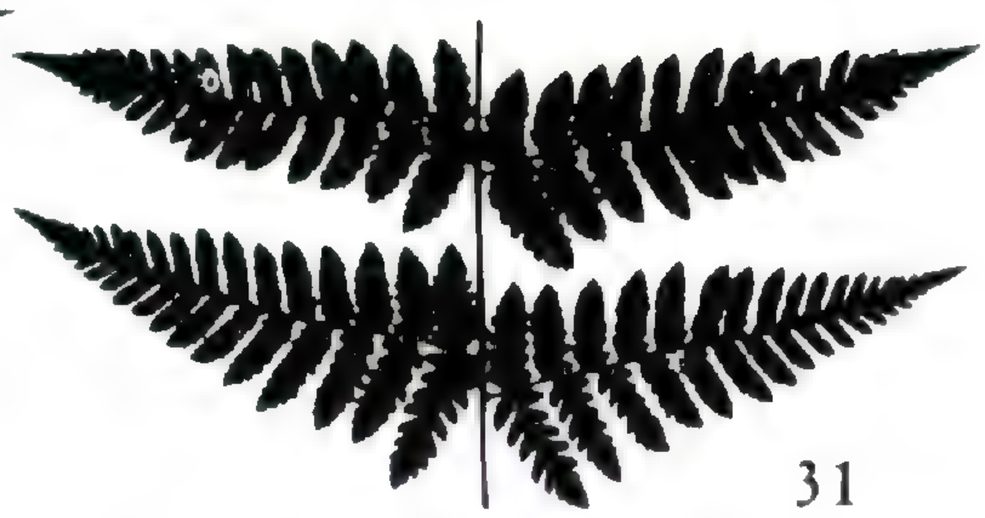

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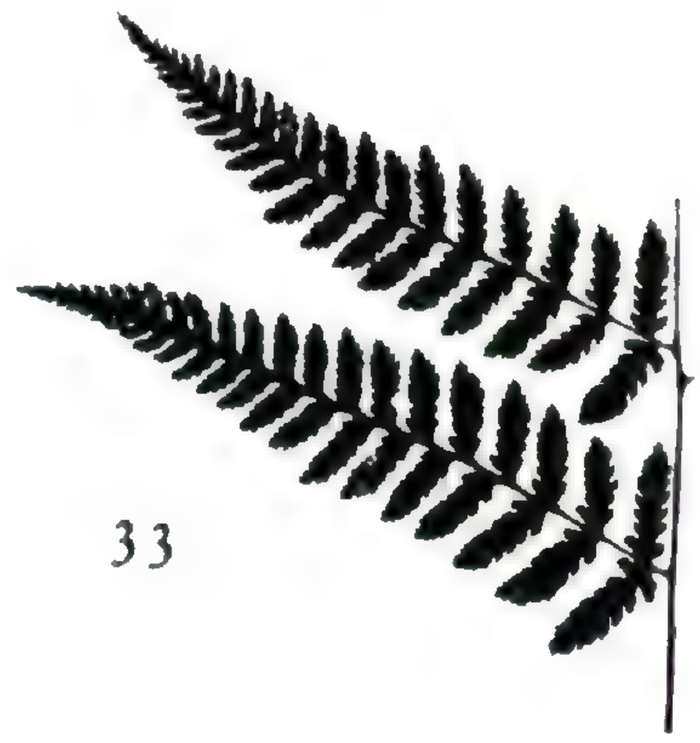

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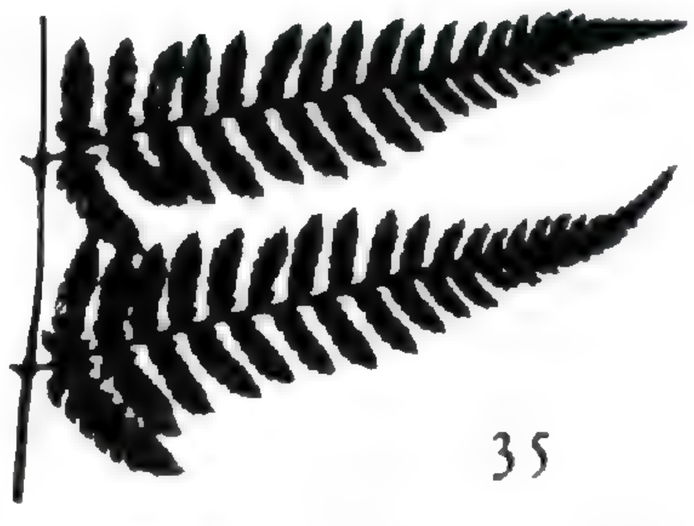

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PLATE 1327

Figs. 30-35. Central pinnae of *Dryopteris spinulosa* var. *spinulosa*, tetraploid, × 1/3. Fig. 30 — from Plant 33. Fig. 31 — from Plant 370. Fig. 32 — from Plant 79. Fig 33 — from Plant 305. Fig. 34 — from Plant 488. Fig. 35 — from Plant 289.

h. Aspect of the lamina.

The aspect of the lamina is usually different in *spinulosa* and *intermedia*. This may be readily observed in fig. 5 of *intermedia* and fig. 9 of *spinulosa* which are characteristic of each taxon. One of the initial objectives of this study was to analyze the general character of aspect into its individual components. This objective was partially but not wholly

realized. Characters *c* to *g* are individual characters of aspect and our analyses of these, therefore, also represent an analysis of aspect. Other individual characters have not been analyzed and among these may be mentioned shape, symmetry, spacing and complexity of the pinnae, of the pinnules and of the tertiary segments, and the length, shape and orientation of the marginal teeth.

Figures 17 to 35 illustrate the central pinnae of leaves that were selected to present the variation in aspect of the three cytotypes. Common aspects of *intermedia* are illustrated by figs. 21 and 23, of the *hybrid* by figs. 25 and 27, and of *spinulosa* by figs. 31 and 35. The other figures of 17-35 represent less common variations. The greatest resemblance of *intermedia* to *spinulosa* is seen in figs. 20 and 34. The aspect of the *hybrid* seems to intergrade with that of both of its parents. Figure 17 of *intermedia* is close to fig. 29 of the *hybrid* and fig. 19 of *intermedia* is close (except in the orientation of the pinnae) to fig. 24 of the *hybrid*. The aspect of the *hybrid* and *spinulosa* is similar in fig. 27 of the *hybrid* and fig. 33 of *spinulosa*, and in fig. 26 of the *hybrid* and fig. 34 of *spinulosa*.

i. Glandularity of the indusium.

Glands of the same type as those on the lamina also occur on the indusium of *intermedia* and the *hybrid*. The indusium of *spinulosa* is glabrous. Eighty-one per cent of the 89 plants of *intermedia* had the indusia definitely glandular and nineteen per cent had them slightly glanduiar; eighty-five per cent of the 47 plants of the *hybrid* had the indusia definitely glandular and fifteen per cent had them slightly glandular. These observations were made only on the cytological voucher leaves, collected in early summer, since the glands tend to be deciduous with age. However, in both *intermedia* and the *hybrid*, glands were also observed on the indusia of leaves that had lived over the winter.

j. Spores.

Our observations of the spores of numerous plants of *intermedia* and *spinulosa* showed them to be normal in ap-

pearance and presumably viable. Only rarely was an abortive spore seen. The spores of the *hybrid*, on the other hand, were uniformly shriveled (abortive). No normal appearing spores were seen among those of the *hybrid* although some effort was made to find them.

k. Chromosome number.

The chromosome counts, already mentioned, may be summarized here for the sake of a complete list of the characters studied,

intermedia: diploid, $n = 41$ (89 plants).
hybrid: triploid, $n = \frac{123}{2}$ (47 plants).
spinulosa: tetraploid, n = 82 (52 plants).

DISCUSSION.

Variation in the cytotypes. —

In relation to the numerical as well as the geographical limitations of our sample, it is desirable that some assessment be made of the parameters of the variation that have been established in our study. An effort was made to obtain a cytological analysis of as many variants as possible and we believe that most of the variation was obtained in the areas sampled. Nevertheless, it is patent from a study of materials in the Gray Herbarium and the Herbarium of the New England Botanical Club that there is greater variability in the *Dryopteris spinulosa* group than in our cytologically determined samples of it. For this reason we are reluctant to place reliance on our parameters as those of the taxa and their hybrid. We feel that most of the parameters can be extended by further cytological sampling, especially in other regions. The means of the characters, however, and the mean of the means, can probably be extrapolated with some confidence as representative of the taxa and the hybrid because of the inertia of the mean.

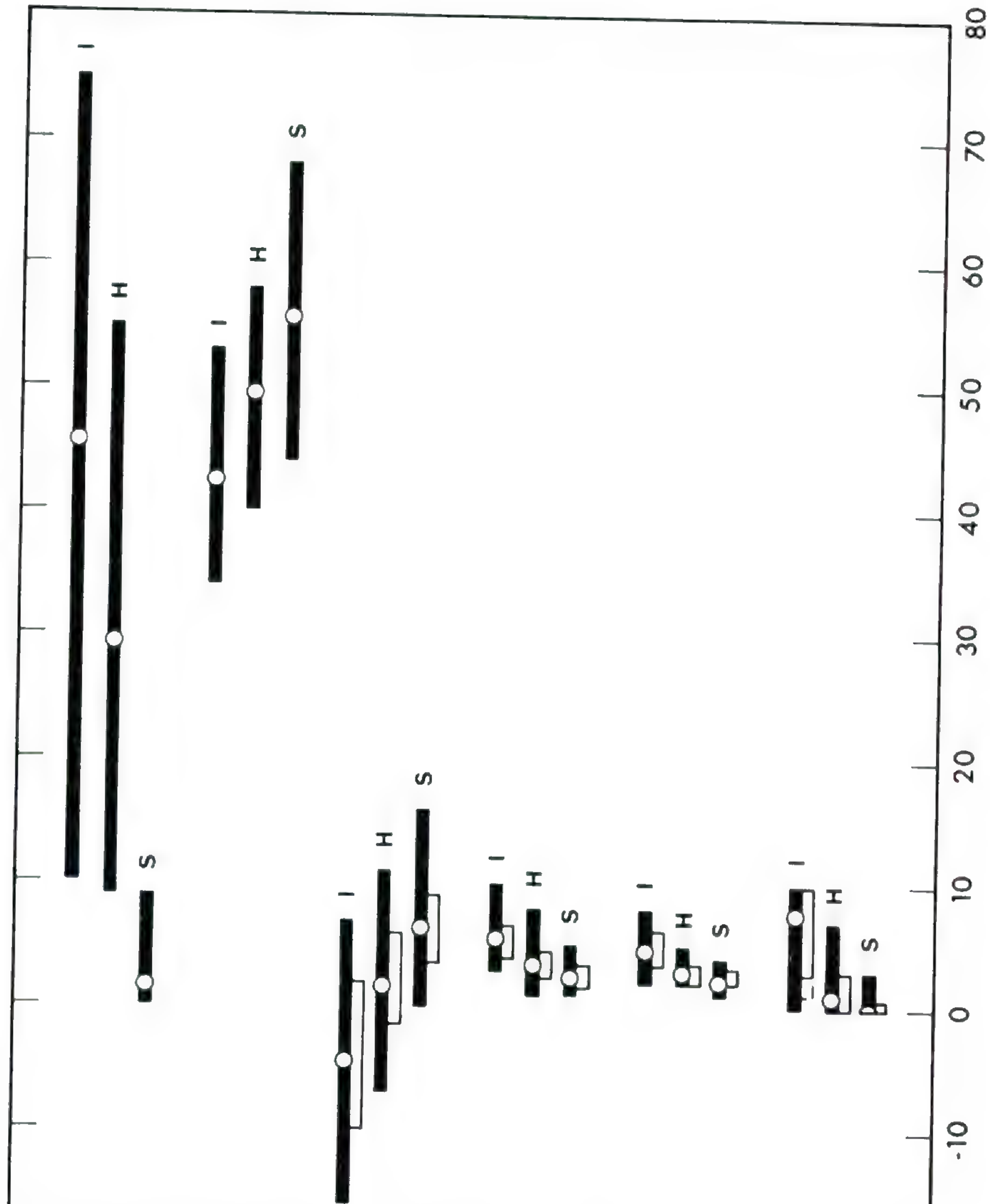
The range of variation of the original counts and measurements is presented in Graph 1. It is portrayed more clearly in Graph 2 where the original data has been adjusted for comparative purposes. Considering the data from all leaves,

CHART 3. Analysis of variation in *Dryopteris spinulosa*, adjusted scores (see text) of characters *a* to *f*. (See Graph 2.)

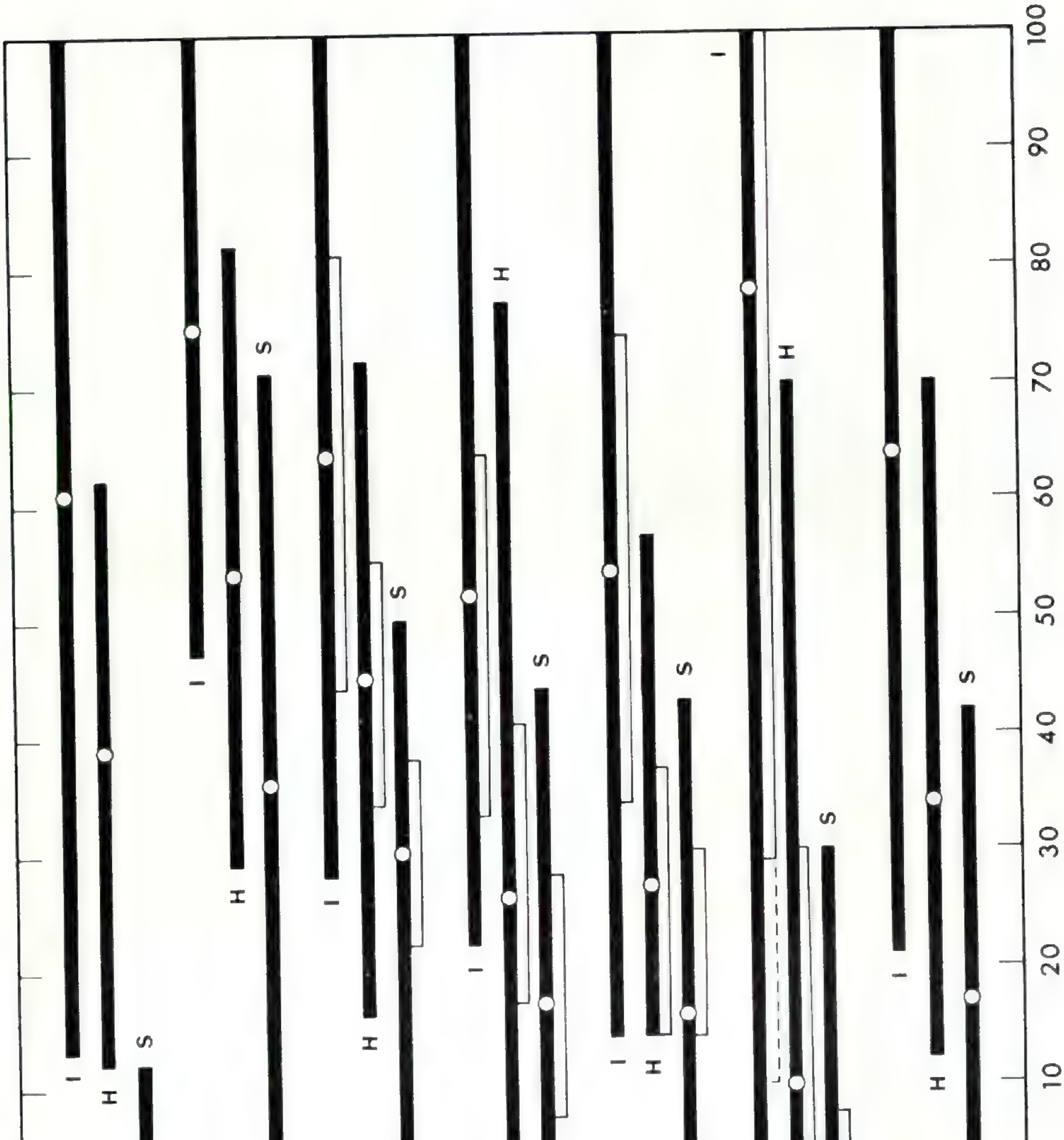
Character.		Range of variation. All leaves.	Mean of plants with 4 or more leaves.	Mean of all leaves.
a	*intermedia*	13-100		61
	hybrid	12-62		39
	spinulosa	0-12		2
b	*intermedia*	47-100		75
	hybrid	29-82		54
	spinulosa	0-71		36
c	*intermedia*	28-100	44-81	64
	hybrid	16-72	34-55	45
	spinulosa	0-50	22-38	30
d	*intermedia*	22-100	33-64	52
	hybrid	0-77	17-41	26
	spinulosa	0-44	7-28	17
e	*intermedia*	14-100	34-74	54
	hybrid	14-57	14-37	27
	spinulosa	0-43	14-30	16
f	*intermedia*	0-100	10*-29-100	78
	hybrid	0-70	0-30	10
	spinulosa	0-30	0-7.5	0.7
		Mean range of variation.		Mean of means.
a to f	*intermedia*	21-100		64
	hybrid	12-70		34
	spinulosa	0-42		17

*Plant 357 with two leaves.

it will be seen in Graph 2 that the range of variation (minimum to maximum score) of each cytotype overlaps that of the others in characters *b* to *f*. In character *a*, the range of variation of *intermedia* and the *hybrid* overlap while that of *spinulosa* is contiguous, or nearly so, with the range of those two. The range of variation of the mean of plants with four or more leaves is presented for characters *c* to *f*. In



GRAPH 1. Analysis of variation in *Dryopteris spinulosa*, original counts and measurements of characters *a* to *f*, from Charts 1 and 2. White dot: mean of all leaves. Bars indicate range and extent of variation of a character. Solid bar: all leaves. Outline bar: plant means from plants with four or more leaves (extension by dash of character *f* in *intermedia* includes Plant 357 with only two leaves). I: *intermedia*, H: *hybrid*, S: *spinulosa*.



GRAPH 2. Analysis of variation in *Dryopteris spinulosa*, adjusted scores of characters *a* to *f*, from Chart 3. White dot: mean of all leaves. Bars indicate range and extent of variation of a character. Solid bar: all leaves. Outline bar: plant means from plants with four or more leaves (extension by dashes of character *f* in *intermedia* includes Plant 357 with only two leaves). I: *intermedia*, H: *hybrid*, S: *spinulosa*.

the means of plants the range of variation of *spinulosa* and *intermedia* is discrete in each character, while that of the *hybrid* overlaps the variation of both parents in each of them. The extent of variation (maximum score minus the minimum) of the means of plants is about half that of the extent of the variation of single leaves.

The mean of each character is strikingly different in *spinulosa* and *intermedia*. The mean of the *hybrid* falls between those of the parents. In characters *a* to *c* it is more or less midway between the parental means, while in characters *d* to *f* it is closer to the mean of *spinulosa*. The mean of the means of the six characters demonstrates that, in these, the *hybrid* falls somewhat closer to *spinulosa* than to *intermedia*. We do not wish to imply, however, that this may represent the actual genetic position of the *hybrid* for in other characters it is closer to *intermedia*.

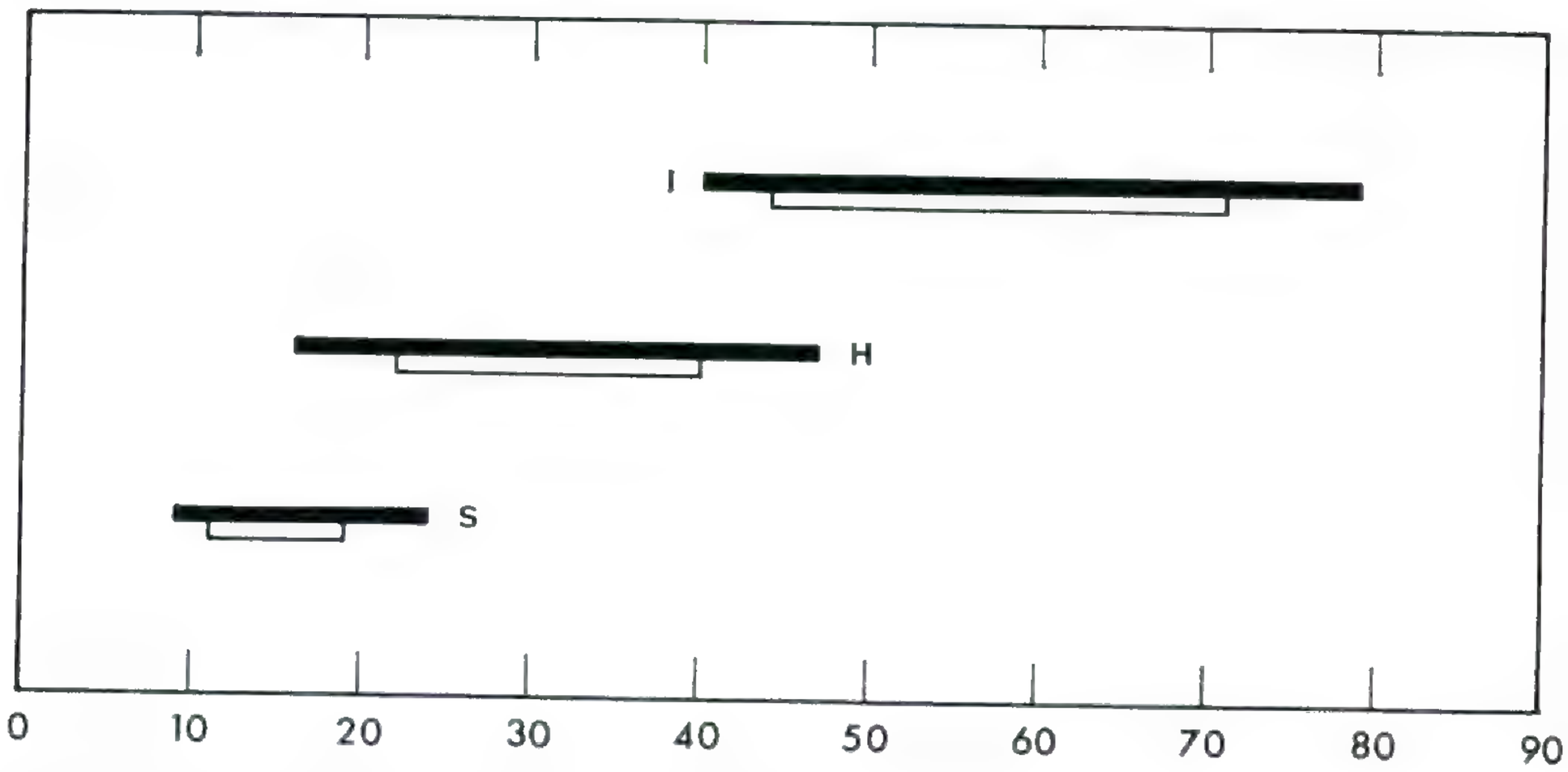
It will be noted also in Graph 2 that in most cases the mean of a character is more or less centrally located between the extremes, while in a few cases it is notably close to one extreme. This is especially true of character *a* in *spinulosa* and of character *f* in all of the cytotypes. The genetic factors which might control these characters would be worthwhile to investigate. At the moment nothing is known of the inheritance of any character in *Dryopteris*. Information concerning numbers of pairs of genes, dominance relationships and factor interaction is lacking.

It can be seen in Graph 2 that the extent of variation in a character is usually greater in *intermedia* than in *spinulosa*. In characters *a*, *e* and *f* the extent of variation in *intermedia* is twice as great, or more, than in *spinulosa*. In characters *c* and *d* it is about half again as great in *intermedia* than in *spinulosa*. Only in character *b* is the extent of variation greater in *spinulosa* than in *intermedia*. In each of these characters the extent of variation in the *hybrid* is equal to or greater than that in the less variable parent and smaller than that in the more variable parent. This comparison of variation is summarized in Graph 2 by the bars that indicate the mean range (and extent) of variation of

CHART 4. Analysis of variation in *Dryopteris spinulosa*. Range and extent of variation between extreme leaves and plants in the means of adjusted scores (see text) of characters *a* and *c* to *f*. (See Graph 3.)

		Character and score.					Mean of scores.	Range and (extent) of variation of mean.
		a	*c*	*d*	*e*	*f*		
intermedia	Leaf from *Plant*..VJV	13	48	33	57	40	40	40-79 (39)
	Leaf from Plant 104	66	75	78	86	90	79	
hybrid	Leaf from Plant 126	12	22	33	14	0	16	16-47 (31)
	Leaf from Plant 95	44	47	78	57	10	47	
spinulosa	Leaf from Plant 91	0	8	22	14	0	9	9-24 (15)
	Leaf from Plant 370	0	34	33	43	10	24	
		Character and mean of plant					Mean of means.	
		a	*c*	*d*	*e*	*f*		
intermedia	Plant 101 4 leaves	13	52	33	64	57	44	44-71 (27)
	Plant 113 4 leaves	55	80	56	74	92	71	
hybrid	Plant 284 6 leaves	12	38	30	29	3	22	22-40 (18)
	Plant 116 4 leaves	73	50	33	36	10	40	
spinulosa	Plant 36 13 leaves	3	27	13	14	0	11	11-19 (8)
	Plant 43 8 leaves	5	38	21	30	0	19	

all six characters (mean of the minimum scores to mean of the maximum). The extent of variation is almost twice as great in *intermedia* (79) as in *spinulosa* (42), while in the *hybrid* it is quite intermediate (58) between the two.



GRAPH 3. Analysis of variation in *Dryopteris spinulosa*, range and extent of variation in means of adjusted scores of characters *a* and *c* to *f*, from Chart 4. Solid bar: variation between extreme leaves. Outline bar: variation between extreme plants. I: *intermedia*, H: *hybrid*, S: *spinulosa*.

The greater extent of variation of the characters of *intermedia* is consistent with the opportunities for recombination and mutation to be expressed phenotypically at the diploid level and the smaller extent of variation of *spinulosa* is consistent with the restrictions on their expression at the tetraploid level.

The variation as represented by extreme leaves and extreme plants and the extent of variation between them is given in Chart 4 and in Graph 3. It will be seen that the extent of variation among extreme leaves and extreme plants is more than twice as great in *intermedia* as in *spinulosa* while in the *hybrid* it is about midway between that of the parents. The fact that the extent of variation in individual characters, in extreme leaves and in extreme plants of the *hybrid*, is so nearly intermediate between that of the parents implies that the hybrid plants we have analyzed have come from the whole spectrum of variation of the parent plants as we have seen it.

One of the most interesting aspects of the variation of the cytotypes is their intraplant variability. Data on this variation, from selected plants, are presented in Chart 5.

The last column of the chart gives the extent of the intraplant variation as a *per cent* of the total extent of variation in the cytotype. Most commonly the intraplant variation is rather small and this is illustrated by plants 27 and 301 which show the variation in the leaves of a plant in one year (one crown) and plants 36 and 38(1959, 1960) which show the variation in the mean of crowns in successive years. The frequent extent of intraplant variation of a character is about 15%, or less, of that of the cytotype. Rarely the intraplant variation may be great and this is illustrated in plants 38(1959) and 504 which show the variation in the leaves of a plant in one year and plants 32 and 117 which show the variation in the mean of crowns in successive years. These examples illustrate that rarely the extent of variation of a character in one plant may be 70%, or more, of that of the cytotype or, as in plant 117, may even exceed that of the cytotype. (This is due to the fact that in Chart 3 the mean of plants is derived from all available leaves of a plant rather than only those of a single crown.)

The genetic implications of the great intraplant variability suggest that the genes controlling these characters are not markedly different in *intermedia* and *spinulosa*. They also suggest that the expressivity of the genes is extremely variable, providing that no unusual mitotic divisions are involved and that the cells of a plant all have a characteristic genotype. Similar variability in gene expression is well known in other plants, for example, the leaves of *Morus alba*. The taxonomic implications are that it vitiates, to a degree, the differences between the taxa brought out by the difference in their means of these characters.

The only character that we have studied in which no variation was observed within a cytotype was the chromosome number. Although both the spores and the indusia have been grouped into two discrete classes: normal-abortive and glabrous-glandular respectively, there is in fact variation in both of these characters. We have not studied the proportion of normal to abortive spores in *spinulosa* and *intermedia*,

CHART 5. Intraplant variation in *Dryopteris spinulosa*. Range and extent of variation of single characters in selected plants. Data on individual leaves are in roman type, data of means of plants are in *italic*.

Plant, cytotype and material.	Character.	Range of Variation. Original data.	Adjusted scores.	Extent of Variation In example as % of cytotype. In example.	In cytotype.	
Plant 301, *hybrid*, 5 leaves, 1960	*c*	0.5 mm. longer to 3 mm. longer	41-48	7	56	12%
Plant 27, *intermedia* 4 leaves, 1960	*d*	5 to 6	44-56	12	78	15%
Plant 504, *spinulosa*, 4 leaves, 1961	*c*	4 mm. longer to 15 mm. longer	3-38	35	50	70%
Plant 38, *hybrid* 5 leaves, 1959, 3 in 1960.	*c*	6.5 mm. shorter to 9.5 mm. longer	20-70	50	56	90%
Plant 36, *spinulosa*, 4 leaves, 1959, 5 in 1960	*c*	*7.2* mm. longer in '59 to *7.4* mm. longer in '60	*27-28*	*1*	*16*	*6%*
Plant 38, *hybrid* 5 leaves, 1959, 3 in 1960.	*c*	*1* mm. longer in '59 to *1.8* mm. longer in '60	*44-47*	*3*	*21*	*14%*
Plant 32, *hybrid*, 4 leaves, 1959, 3 in 1960	*f*	*2* in 1959 to *4.3* in 1960	*20-43*	*23*	*30*	*77%*
Plant 117, *hybrid*, 3 leaves, 1959, 3 in 1960	*e*	*3.66* in 1959 to *1.66* in 1960	*9-38*	*29*	*23*	*126%*

being content with the observation that the abortive spores are rare. The glandularity of the indusium of *intermedia* and of the *hybrid* is clearly variable and although this has not been studied in detail it seems to show a range of variation similar to that of the pinna base in *intermedia* and the *hybrid*.

Identification. —

Identification is most readily made during the rather brief time when mature spores are present in abundance. There is a possibility of contamination when there are only a few spores. During this two or three week period, the *hybrid* is readily identified by its abortive spores, *intermedia* by its normal spores and glandular indusium and *spinulosa* by its normal spores and glabrous indusium. Before, or after, this period fertile leaves of *spinulosa* may be identified by their glabrous indusium but *intermedia* and the hybrid cannot be distinguished from each other by the indusium. Sterile material of *spinulosa* or *intermedia* cannot always be distinguished from the *hybrid*. The difficulties of identification, then, center on the many herbarium specimens and plants in nature that are collected or observed at a time when uncontaminated mature spores are not present. Other characters must then be employed, if possible, for identification and it is with these that this study has largely been concerned.

We have mentioned our conclusion that the parameters of the characters we have studied are undoubtedly greater in the taxa and their hybrid than in our sample of them. For this reason we do not believe that any of the data on single characters (Charts 1, 2 and 3, Graphs 1 and 2) afford a basis for the identification of all plants of the cytotypes. In all of the characters, except *a*, the range of variation of one cytotype overlaps that of another (or both) and in character *a*, the range of *spinulosa* is very close to that of the other two.

The data on extreme plants (Chart 4, Graph 3), derived from the mean of 5 characters, shows that the range of variation of each cytotype is distinct from that of the other

two. However, the degree of distinction is small: a difference (in the mean of the adjusted scores) of 3 between plant 43 of *spinulosa* (19) and plant 284 of the *hybrid* (22) and a difference of 4 between plant 116 of the *hybrid* (40) and plant 101 of *intermedia* (44). We do not believe that these small differences afford a basis for the identification of all plants of the cytotypes.

It seems worthwhile to emphasize the variability of character *c*, the relative length of the inferior basal pinnules on the basal pinnae and the adjacent ones, because this character has been much relied upon in the literature for purposes of identification. Chart 2 and figs. 11-12, 15-16 demonstrate the variability in this character. *Intermedia* usually has the inferior basal pinnules shorter than the adjacent ones (fig. 11), but they may be longer (fig. 12) and *spinulosa*, usually has the basal inferior pinnules longer than the adjacent ones (fig. 16), but they may be equal in length (fig. 15). The great variation among the leaves of one crown can be seen in Chart 5, Plant 38 (1959) in which one of the five leaves had the inferior basal pinnules 6.5 mm. shorter than the adjacent ones and another leaf had them 9.5 mm. longer.

The evergreen quality of the leaves has also been emphasized in the literature and it is generally true that leaves of *spinulosa* are deciduous and those of *intermedia* are evergreen. However, our limited observations have indicated that this character is a variable one especially influenced by the environment of the individual plant. In most of the plants of the *hybrid* that were studied the leaves were deciduous or only partially evergreen but in some they were evergreen as is typical *intermedia*.

Other characters employed in the identification of the taxa and their hybrid that we have also found to be too variable to be utilized are the position of the pinnae in relation to the rachis (see Analysis of Characters, *g*.) and the aspect of the lamina (see Analysis of Characters, *h*). Considering the variability discovered in all of the characters mentioned, we feel that others such as the orientation of

the rhizome, the color of the petiole scales and the type of spines on the spores cannot be accepted as affording a distinction of the taxa until their constancy has been confirmed by an extensive study of plants of known identity.

There remain then as wholly applicable characters for identification of the cytotypes only the glandular or glabrous indusium, the abortive or normal spores and the chromosome number. Certain extremes of other characters do seem sufficiently distinctive to allow some confidence in their use and these have been added to the key. It will be obvious that the key will not allow the identification of all material.

Key.

Indusium glandular.
  Spores normal; $n=41$. (Any leaf with 9-10 basal inferior pinnules on the lowest 10 pinnae overlying the rachis, or any plant with four or more leaves averaging 6-10 overlying pinnules probably belongs here.) ..... *intermedia*
  Spores abortive; $n=\frac{123}{2}$. (Any plant with a glandular indusium and four or more leaves averaging 0 overlying pinnules probably belongs here.) ..... *hybrid*
Indusium glabrous; spores normal; $n=82$. (Any leaf with the pinna-bases glabrous probably belongs here.) ..... *spinulosa*

Classification. —

The authors are in amiable, but firm, disagreement about the proper taxonomic status of *intermedia* and *spinulosa*. Donald M. Britton is of the opinion that, in these taxa, the cytogenetic evidence must be decisive. *Intermedia* is a basic diploid taxon genetically isolated from *spinulosa* which is a derived polyploid taxon. Accordingly, the status of species is most appropriate for each of them. Rolla Tryon is of the opinion that the taxonomic status of *intermedia* and *spinulosa* must be determined by a comparision of the two to each other and to other taxa in their alliance on the basis of all evidences of similarity and difference. He is of the opinion that the similarities and differences brought out in the present study make the category variety most appropriate, at the same time admitting that this status is tentative pending adequate comparative studies of other allied taxa.

It is difficult to decide whether or not the *hybrid* should be treated as a taxon and then be designated by a binomial. Rather than explore this complex question here we prefer not to recognize it as a taxon but to formally refer to it by the appropriate formula. This is advantageous because it directly conveys the parentage which is the most important information about a hybrid.

The triploid hybrid. —

There are several aspects of the natural history of the sterile *hybrid* that deserve some additional discussion. Although its distribution is not well known, its presence has been cytologically confirmed in Ontario, Massachusetts, New Jersey, Virginia and Michigan. It is probably to be found throughout northeastern United States and adjacent Canada within the range of the two parents and in most localities where they both grow. We have found it at all (seven) localities where cytological sampling revealed the presence of both *intermedia* and *spinulosa*. In Massachusetts, it has been found at each of several localities where a search was made for it. Most of these plants were identified by their abortive spores; a few were identified by their chromosome number. The data in Chart 6 suggest the abundance of the *hybrid* in a few localities and also demonstrate how it may be more abundant than either parent. We have observed in the same locality that the triploid plants often have larger leaves and more leaves than those of the parents. While this might be due to environmental conditions that are more favorable for it than for either parent, it seems more likely that it is due to the phenomenon of hybrid vigor.

The hybrid plants may arise in two ways. The plant may come from the fertilization of a gametophyte of one parent by one of the other parent, or it may come from an existing plant by vegetative reproduction. Although we have seen some evidence of clonal development in the *hybrid* we have not been able to assess the relative importance of this in the formation of populations. The principal reason being that although a close similarity of plants that are near each other may be taken as evidence of a clone, it does not follow

CHART 6. Relative abundance of *Dryopteris spinulosa* at four localities, from random samples of the populations.

Locality.	Number of plants.	% of population.
'High and Dry', Wellington Co., Ontario.		
intermedia	16	19
hybrid	56	65
spinulosa	14	16
Cockburn Swamp, Wellington Co., Ontario.		
intermedia	3	11
hybrid	14	52
spinulosa	10	37
Sodom, Halton Co., Ontario.		
intermedia	16	31
hybrid	20	38
spinulosa	16	31
Littleton, Massachusetts.		
intermedia	26	27
hybrid	62	64
spinulosa	9	9

that dissimilar plants always represent independent hybrids. The data in Chart 5 on variation in a crown from one year to the next (plants 32, 117) are sufficiently suggestive of the variability that may be present in a clone to make its identification in the field most uncertain.

Some estimate of the extent of clonal development may be made by measuring the growth of the rhizome apex. The growth of the adult rhizome extends the apex some two or three centimeters a year and when the apex occasionally branches two separate plants are soon produced. Lateral stolons are also commonly produced from between the persistent leaf bases, on the older portions of the rhizome. These are slender and grow three or four centimeters in length before the internodes shorten and a crown of small leaves is produced. The base of the stolon soon dies and the rhizome of the small separate plant then may spread away from the parent. The spread of a clone by these two methods is rather slow and it would not occupy more than fifty to a hundred square meters of area in a few hundred years.

In many localities where the *hybrid* grows, it occupies an area of several thousand square meters. Even allowing

for maximal clonal development, each of these large populations must represent a few dozen, or even a few hundred, original hybrid plants. Such populations must occur frequently over an extensive area, at least from Virginia to New England, Ontario and Michigan, and they must represent several hundred thousand F_1 plants.

This frequency of crossing of the parental gametophytes can be evidence of the breeding behavior of the parents themselves. Since the gametophytes of the two taxa can cross with some frequency, those from different plants of the same taxon should do so with equal or greater frequency. Although we do not have sufficient data on the population structure of *intermedia* and *spinulosa* to bring to bear as evidence of predominant outcrossing, our data on variation are consistent with the idea that outcrossing occurs. It seems appropriate to bring out this indirect evidence for relatively frequent outcrossing since so little is known about the natural breeding behavior of ferns.

The relative greater abundance of the *hybrid* than either parent (Chart 6) is unusual, perhaps unique, in sterile hybrid ferns. Most of these in *Dryopteris* are rare and occur only as an occasional plant or small colony in a very few of the places where the parents grow together, for example, *D. marginalis* × *spinulosa* var. *intermedia* and *D. Goldiana* × *marginalis*. A few are more common and occur in many localities where both parents grow, for example, *D. cristata* × *spinulosa* and *D. cristata* × *spinulosa* var. *intermedia*. The latter, perhaps more familiar as *D.* × *Boottii*, is the most common hybrid, except for *intermedia* × *spinulosa*, but it is never as abundant as its parents. We believe that the great abundance of *intermedia* × *spinulosa* is due to the large number of hybrid sporelings that are formed and to their intermediate physiological traits. Their physiology may adapt them to a large number of niches favorable for immediate survival. It may also provide them, and older plants, with the capacity to survive drought and pluvial periods, that might diminish the numbers of *spinulosa*, which prefers wet conditions, and also of *intermedia*, which prefers drier ones.

When we first became aware of the frequency of the *hybrid*, we fully expected that further sampling would reveal a hexaploid. Although this expectation was not realized there are some aspects of the triploid hybrid that have a pertinence to studies of naturally occurring hexaploids. One of these aspects is the proximity of extreme plants of the *hybrid* (Chart 4 and Graph 3) to certain plants of the parents. A hexaploid produced from one of these plants would be much closer to one parent than to the other and if the triploid became extinct (or was unknown) the relations of the hexaploid might be correspondingly obscured. Further difficulties in the analysis of the hexaploid would result if it were produced more than once and from plants at the opposite ends of the spectrum of variation of the triploid.

The origin of the tetraploid. —

The hybrid of *spinulosa* and *intermedia* has approximately 41 pairs of chromosomes and 41 single chromosomes and on the basis of this evidence, Walker (1961) has concluded that the parents share a common genome. Therefore, he considers *spinulosa* to be an allopolyploid with *intermedia* as one of its ancestral parents. Among the known diploids only *intermedia* is a credible parent for *spinulosa* and, if *spinulosa* is an allopolyploid, it is evident that the other parent is either extinct or is as yet undetected. It must also be considered, however, that *spinulosa* may be an autopolyploid between two members of an original diploid *spinulosa* taxon which was closely related to *intermedia*.

There are two characters of *spinulosa* that are not consistent with Walker's hypothesis. These are the glabrous indusium and the only slightly and infrequently glandular lamina. A hybrid with typical *intermedia* would be expected to have a glandular indusium and a more glandular lamina as, for example, in *D. cristata* × *spinulosa* var. *intermedia* and in *D. cristata* var. *Clintoniana* × *spinulosa* var. *intermedia*. However, it must be admitted that we can not be certain that the gladularity of *intermedia* is always strongly dominant in its hybrids and so the slight

glandularity of *spinulosa* can only be a qualified objection to Walker's hypothesis.

Our data on the breadth of variation in *intermedia*, and in the *hybrid*, suggest that Walker's interpretation may be correct under certain circumstances. The present data would be sufficiently consistent with his hypothesis if one of the parents of the original hybrid *spinulosa* were a plant of *intermedia* that was rather distant from the central variation of the taxon in the direction of *spinulosa*. It would also be consistent if one of the parents of the original hybrid *spinulosa* was a member of an ancestral *intermedia* that was closer to the present *spinulosa* and which has since diverged from it.

The variation that we have observed in *spinulosa* and in *intermedia* suggests that the origin of *spinulosa* may be a complex problem and that further studies are desirable to substantiate the claim of *intermedia* as one of its parents.

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VARIETIES OF BALLOTA NIGRA IN THE EASTERN UNITED STATES — The Black Horehound, *Ballota nigra* L., common in western Europe both native and as a weed, is an uncommon weed in the eastern and southeastern United States, probably originally introduced mostly on ballast. Although no varieties or forms are mentioned in the eighth edition of Gray's Manual, it does occur in two rather easily distinguishable forms, which are called in the New Britton and Brown Illustrated Flora var. *foetida* Vis. and var. *ruderalis* Koch, but these names are not correct. The former has the calyx lobes short and abruptly cuspidate at the apex, whereas the latter has them long-triangular and gradually acuminate.

Dr. A. Patzak, of the Naturhistorisches Museum, Wien, published some time ago a revision of *Ballota*,[1] in which seven subspecies of *B. nigra* L. are recognized. Recently, a number of plants introduced into the United States were submitted to Dr. Patzak for study, and came back annotated partly as subsp. *foetida* Hayek and partly subsp. *nigra*. There can be no question as to the correctness of the latter name; as a variety it would be called var. *nigra*, of which var. *ruderalis* (Swartz) Koch is a synonym. The former name is not a new entity with Hayek (Repert. Sp. Nov. Fedde Beih. 30 (2) : 278. 1929), but was based ultimately on *Ballota foetida* Lam. (Fl. Franc. 2: 381. 1778), which was merely a change of name for *B. nigra* L., and was thus superfluous when published and illegitimate. However, an originally illegitimate epithet like *foetida* can be validated in another category by a later author, who in this instance appears to be Koch, who published the variety *B. nigra* L. var. *foetida* Koch (Syn. Fl. Germ. Helv. 572. 1837), which must be considered as a new variety and not a transfer of *B. foetida* Lam. The authority for the combination *B. nigra* subsp. *foetida* should therefore be (Koch) Hayek, rather than merely Hayek.

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[1] "Revision der Gattung Ballota Section Ballota," Annal. Naturhist. Mus. Wien **62:** 57-86. 1958.

When this plant is considered to be a variety, as such plants commonly are in floras of the eastern United States, the epithet will not be the same. Hayek was the first (apparently, according to Patzak's synonymy) to propose a subspecific epithet, and *foetida* thus has priority in this rank, but there were earlier varietal names proposed for this plant. Linnaeus himself realized, after the publication of *B. nigra* in the Species Plantarum of 1753, that there were two entities involved, and for the second he proposed *Ballota alba* L. (Fl. Suec. ed. 2, 206. 1775), which is the plant with short, cuspidate calyx lobes that is called subsp. *foetida* by Patzak. As a variety its correct name will be *B. nigra* L. var. *alba* (L.) J. E. Smith (Brit. Fl. 2: 635. 1804).

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PASPALUM MINUS (GRAMINEAE) IN LOUISIANA AND MISSISSIPPI[1]

Recently I reported Mobile, Alabama as a new location for *Paspalum minus* Fourn. (Banks, 1964). In the United States the species had been known previously in eastern Texas, near Fannett, Beaumont, and Anahuac. According to Jones et al. (1961), *P. minus* was collected by Silveus in Aransas county in southeastern Texas. My Mobile collection extended the range of the species considerably but appeared to be isolated from the other locations.

Last summer, while I was collecting plants for my *Paspalum* studies, I found *P. minus* growing in Louisiana and Mississippi. The Mississippi collection was made two days after the Louisiana one during a field trip with Dr. Thomas Pullen, Department of Biology, University of Mississippi.

[1]Contribution No. 64 from the Stephen F. Austin State College Department of Biology.

Dr. Pullen arranged for lodging facilities at the University Forest Lands and provided local transportation to the collection site for which I am grateful. These new locations help to bridge the gap between the Texas and Alabama stations and indicate that the species is probably more widespread in the Gulf Coastal Plain than we have realized.

I contacted the following curators in Texas, Louisiana, and Mississippi to determine if other locations for the species might be known: Joseph Ewan (NO), Frank Gould (TAES), G. W. Johnston (MISSA), Thomas Pullen (UNIV. OF MISS.), Claude McLeod (SHST), Lloyd Shinners (SMU), John L. Strother (TEX), Clair A. Brown (LSU) and John Thieret (LAF). I wish to thank the above persons for checking the locations of *P. minus* in their herbaria and for allowing me to include the information in this paper.

This correspondence did not reveal additional locations in Louisiana or Mississippi. Additional locations in Texas are, according to Strother[2], Smith Point, and according to McLeod[2], Weldon, Lovelady, Diboll, Huntsville, and Groveton to Trinity.

I do not know how *P. minus* was introduced into the United States. It is possible that hurricanes carried seeds from the West Indies. Another possibilty is that it may have been introduced in foreign imports of seeds of *Paspalum notatum* Flügge (Bahiagrass). *P. notatum* is becoming widespread in its distribution in the southeast, especially along highways and in pastures where it is often planted for erosion control and for forage. *P. minus* closely resembles *P. notatum*, the former being only slightly smaller in most characteristics, and probably accounts for its having been unnoticed. Closer observation may reveal additional specimens of *P. minus* in colonies of *P. notatum*.

Cytological examination of the Louisiana and Mississippi material using the aceto-carmine squash method revealed 10 chromosomes in the microspores and meiosis appeared normal. See Figure 1. Gould (1958) reported $n=20$ in the Huntsville material which was collected by McLeod[2]. My

[2]Personal communication.

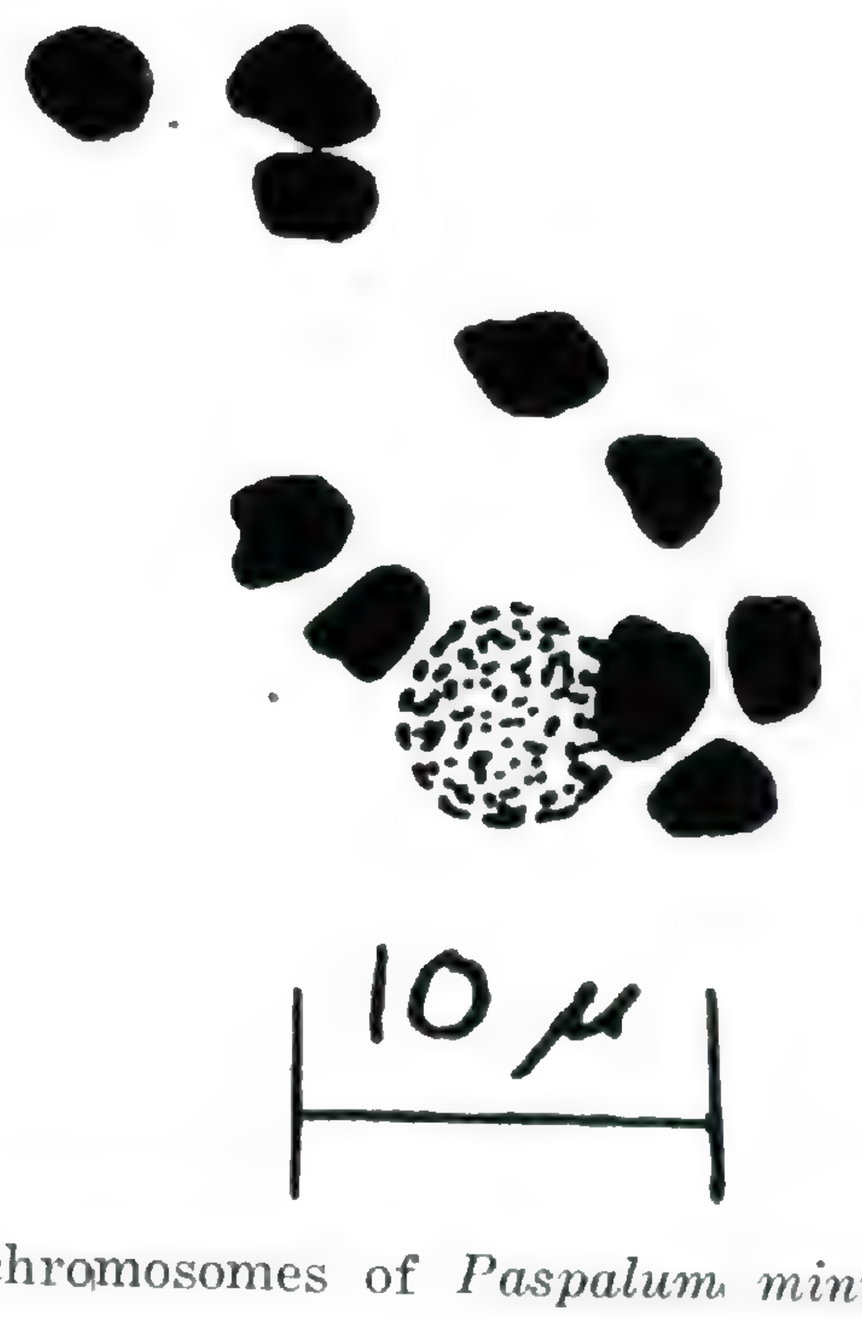

Fig. 1. Meiotic chromosomes of *Paspalum minus* (Banks 3500). $n = 10$.

report therefore represents a new chromosome count for *P. minus* and indicates that some races are diploid.

My collection data for *P. minus* in Louisiana and Mississippi and the disposition of specimens are as follows:

LOUISIANA. ST. TAMMY PARISH: Edge of Pine woods along a wet ditch about 1.6 miles east of Abita Springs along Louisiana State Highway 36. Scattered clumps. *D. J. Banks 3395*. July 16, 1964. (ASTC, GH, LSU, MO, NO, NY, SMU, US).

MISSISSIPPI. JACKSON COUNTY: In low pinelands in a wet ditch about 8 miles south of Vancleave. Plants erect. *D. J. Banks 3500*. July 18, 1964. (ASTC, GH, MISSA, MO, NY, SMU, University of Mississippi, University of Southern Mississippi, US).

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GOULD, F. W. 1958. Chromosome numbers in southwestern grasses. Am. Jour. Bot. **45**: 757-767.

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STUDIES IN THE FLORA OF BOLIVIA — IV.

GRAMINEAE

ROBERT C. FOSTER

To anyone who has made use of Hitchcock's treatment of the central and northern Andean grasses (Contrib. U. S. Nat. Herb. 24, pt. 8 [1927]), my indebtedness will be obvious. I have followed it in the arrangement of genera and species, with such interpolations as time and the accretion of further material have made necessary. Since Hitchcock's work was published almost forty years ago, it is not surprising that genera and species not known to him from Bolivia have now been found there. In the matter of species-concepts and synonymy, too, Hitchcock has been followed, almost without exception. This is conservative, perhaps ultraconservative, but that seems preferable to over-recognition of categories of possibly uncertain value. It also means that if Hitchcock made errors they are perpetuated here.

A non-agrostologist is perhaps too greatly impressed by the number of exceptions and qualifications made necessary in writing keys if the genera are first divided into tribes. Consequently, a continuous key is provided for the 109 genera treated in this paper. It is based, like the generic descriptions, on the species found in Bolivia, not on extra-territorial species. Certain points as to its terminology should be noted. A fertile floret may be either perfect or pistillate; when necessary, specific use is made of one term or the other. A sterile floret may be staminate, neuter, or a rudiment. Most often, the term is applied to an empty lemma. Again, a primary division is made on the basis of the disarticulation of spikelets — above the glumes and not above the glumes. This phraseology has been deliberately used rather than above the glumes and below the glumes. It is made necessary by the fact that in some genera both glumes are lacking. Disarticulation may also occur in the pedicels or in the rachis itself, which is somewhat too far

below the glumes to permit even a broad use of that expression.

Once again, this paper is based on the collections of the Gray Herbarium (GH). These have been supplemented by material borrowed from the incomparable collection of *Gramineae* in the United States National Herbarium (US). I am much indebted to Dr. W. L. Stern and Dr. T. R. Soderstrom for their generous coöperation. In some cases, where Bolivian material has not been seen, collections seen by previous workers have been cited, with that worker's name in parentheses.

For corrections and additions to this paper, I shall be most grateful.

KEY TO GENERA

1. Inflorescences not surrounded by a hard bony involucre.
   2. Disarticulation above the glumes.
      3. Spikelets 1-flowered.
         4. Inflorescence a solitary, terminal, pedunculate spikelet. ..... 44. *Aciachne.*
         4. Inflorescence not a solitary, terminal, pedunculate spikelet.
            5. Rachilla prolonged as a bristle behind the palea.
               6. Inflorescence not digitate. ..... 37. *Calamagrostis.*
               6. Inflorescence digitate. ..... 57. *Cynodon.*
            5. Rachilla not prolonged behind the palea, except in the central spikelets only in *Hordeum.*
               7. Inflorescence a terminal spike.
                  8. Spikelets 3 at a node, not unilateral on the rachis. ..... 26. *Hordeum.*
                  8. Spikelets solitary at nodes, unilateral on the rachis. ..... 58. *Microchloa.*
               7. Inflorescence a panicle.
                  9. Spikelets paired, 1 pistillate and subsessile, 1 staminate and pedicellate. ..... 67. *Pharus.*
                  9. Spikelets not paired.
                     10. Awn of lemma excentric (in side view).
                        11. Lemma enclosing the membranous palea. ..... 46. *Nassella.*
                        11. Lemma not entirely enclosing the coriaceous bicarinate palea. ..... 47. *Piptochaetium.*
                     10. Awn of lemma not excentric, or lemma awnless or cuspidate.

12. Awn of lemma trifid. ..... 49. *Aristida.*
12. Awn of lemma, if present, undivided.
13. Lemma shorter than glumes.
14. Lemma neither fusiform nor indurate. ..... 38. *Agrostis.*
14. Lemma fusiform, indurate. ..... 48. *Stipa.*
13. Lemma equal to glumes or longer than at least 1 glume.
15. Lemma awnless. ..... 45. *Sporobolus.*
15. Lemma awned or cuspidate.
16. Awn dorsal ..... 43. *Triniochloa.*
16. Awn terminal, if present, otherwise the lemma cuspidate. ..... 42. *Muhlenbergia.*

3. Spikelets more than 1-flowered.
17. Spikelets with fertile florets only.
18. Rachilla villous.
19. Lemma with the true awn 1.1-2.2 cm. long. ..... 16. *Cortaderia.*
19. Lemma with the true awn about 4 mm. long. .... 30. *Koeleria.*
18. Rachilla glabrous.
20. Florets distant, glumes minute. ..... 7. *Aphanelytrum.*
20. Florets not distant, glumes not minute.
21. Spikelets and glumes over 1 cm. long. ..... 14. *Arundo.*
21. Spikelets and glumes less than 1 cm. long.
22. Glumes less than 2 mm. long. ..... 8. *Puccinellia.*
22. Glumes more than 2 mm. long.
23. Glumes shorter than lemmas. ..... 19. *Anthochloa.*
23. Glumes longer than lemmas. ..... 22. *Triodia.*

17. Spikelets with fertile and sterile florets, or the florets all pistillate or all staminate.
24. Plants dioecious.
25. Rachilla villous. ..... 16. *Cortaderia.*
25. Rachilla glabrous.
26. Leaf-blades about 1 mm. wide; inflorescence a rather condensed panicle. .... 13. *Distichlis.*
26. Leaf-blades to 4-6 cm. wide; inflorescence a plumose panicle. ..... 17. *Gynerium.*

24. Plants not dioecious.
    27. Fertile florets above the sterile florets in the spikelet.
        28. Lateral nerves of first glume with a row of tubercles bearing long golden-brown hairs. ..... 70. *Tristachya.*
        28. Lateral nerves of first glume not tuberculate, not with long golden-brown hairs.
            29. Spikelets strongly flattened and imbricate. ..... 64. *Phalaris.*
            29. Spikelets not strongly flattened and imbricate.
                30. Spikelets with more than 1 fertile floret.
                    31. Inflorescence a plumose panicle. ..... 15. *Phragmites.*
                    31. Inflorescence not a plumose panicle.
                        32. Leaf-blades linear, to 6 mm. wide. ..... 1. *Arthrostylidium.*
                        32. Leaf-blades lanceolate, to 3 cm. wide. ..... 2. *Arundinaria.*
                30. Spikelets with only 1 fertile floret.
                    33. Fertile branches fascicled at nodes of main plant-axis; terminal floret perfect. ..... 3. *Chusquea.*
                    33. Fertile branches not fascicled at nodes of main plant-axis; terminal floret pistillate.
                        34. Lemma of pistillate floret glabrous or scabridulous. ..... 68. *Arundinella.*
                        34. Lemma of pistillate floret densely long-pubescent. ..... 69. *Trichopteryx.*
    27. Fertile florets below the sterile florets in the spikelet.
        35. Inflorescence condensed into small glomerules more or less hidden by leaf-sheaths. ..... 63. *Munroa.*
        35. Inflorescence not condensed into glomerules.
            36. Inflorescence digitate or paniculate (in one instance a panicle with whorls of digitately arranged branches).
                37. Inflorescence digitate.
                    38. Rachis prolonged beyond the uppermost spikelet as a short subulate point. ..... 56. *Dactyloctenium.*

38. Rachis not prolonged beyond the uppermost spikelet.
    39. Spikelets with more than 1 perfect floret. ..... 55. *Eleusine.*
    39. Spikelets with only 1 perfect floret. ..... 60. *Chloris.*

37. Inflorescence a panicle.
    40. Lemma wing-margined. .... 11. *Briza.*
    40. Lemma not wing-margined.
        41. Rachilla glabrous.
            42. Glumes or lemmas awned.
                43. Spikelets unilateral in 2 rows on the rachis. .... 61. *Trichloris.*
                43. Spikelets not unilateral on the rachis.
                    44. Lemmas longer than glumes.
                        45. Inflorescence a spicate, dense, interrupted panicle. .... 31. *Trisetum.*
                        45. Inflorescence an open racemose panicle. .... 53. *Gouinia.*
                    44. Lemmas shorter than glumes. .... 59. *Gymnopogon.*
            42. Glumes and lemmas awnless.
                46. Spikelets unilateral on the the rachis in 2 rows. ..... 52. *Leptochloa.*
                46. Spikelets not unilateral on rachis in 2 rows.
                    47. Glumes longer than lemmas.
                        48. Spikelets paired, 1 sessile and 1 pedicellate. .. 34. *Holcus.*
                        48. Spikelets not paired.
                            49. Inflorescence spicate, dense. .. .... 29. *Dissanthelium.*

49. Inflorescence not spicate, the branches distant, spreading. ..... 18. *Melica.*
47. Glumes equal to or shorter than lemmas.
50. Leaf-blades long-petiolate, lance-ovate. .... 21. *Zeugites.*
50. Leaf-blades not long-petiolate nor lance-ovate.
51. Paleas persistent on rachilla after fall of lemmas. .... 12. *Eragrostis.*
51. Paleas not persistent. .. 10. *Poa.*
41. Rachilla not glabrous.
52. Lemma not bidentate.
53. Lemma apically dissected into numerous awns. .... 23. *Pappophorum.*
53. Lemma not apically dissected.
54. Paleas persistent on rachilla after fall of lemmas. .... 12. *Eragrostis.*
54. Paleas not persistent.
55. Spikelets 1.5 cm. long or longer. .... 4. *Bromus.*
55. Spikelets rarely longer than 1 cm., usually shorter.
56. Glumes longer than lemmas. .. .. 18. *Melica.*
56. Glumes equal to or shorter than lemmas.

57. Lemmas awnless. .... 10. *Poa.*
57. Lemmas awned. .... 6. *Festuca.*

52. Lemma bidentate or 4-toothed.
58. Lemma-awn dorsal.
59. Spikelets 1.5-2.5 cm. long. ..... 33. *Avena.*
59. Spikelets 4-5 mm. long. ..... 32. *Deschampsia.*
58. Lemma-awn from base of sinus between teeth.
60. Spikelets about 2.5 cm. long. ..... 4. *Bromus.*
60. Spikelets 1.5 cm. or less.
61. Glumes shorter than lemmas. .... 31. *Trisetum.*
61. Glumes longer than lemmas.
62. Spikelets 1.5 cm. long.
63. Leaves glabrous. ..... 9. *Amphibromus.*
63. Leaves papillate - hirsute. .... 35. *Danthonia.*
62. Spikelets about 7 mm. long. .... 36. *Lamprothyrsus.*

36. Inflorescence neither digitate nor paniculate, but a solitary terminal spike or raceme.
64. Inflorescence a raceme with few, distant, ultimately spreading spikelets. ..... 5. *Brachypodium.*
64. Inflorescence a terminal spike.

65 Spikelets placed edgewise to the rachis. ..... 27. *Lolium.*
65. Spikelets not placed edgewise to the rachis.
66. Glumes awned. ..... 25. *Elymus.*
66. Glumes awnless.
67. Glumes shorter than lemmas. ..... 54. *Tripogon.*
67. Glumes not shorter than lemmas.
68. Plants 1-2 dm. high; spikes 1-3 cm. long. ..... 62. *Bouteloua simplex.*
68. Plants to 1-2 m. high; spikes 7-20 cm. long. ..... 24. *Agropyron.*

2. Disarticulation not above the glumes.
69. Spikelets 1-flowered.
70. Spikelets with unisexual or neuter florets.
71. Inflorescence a spicate panicle or raceme.
72. Inflorescence a raceme.
73. Spikelets in whorls around the rachis. ..... 28. *Pariana.*
73. Spikelets not in whorls around the rachis. ..... 51. *Aegopogon.*
72. Inflorescence a spicate panicle. ..... 41. *Lycurus.*
71. Inflorescence a panicle but not spicate in appearance.
73a. Pistillate and staminate spikelets in separate inflorescences on the same plant. ..... 66. *Luziola.*
73a. Pistillate and staminate spikelets not in separate inflorescences.
74. Spikelets not paired. ..... 94. *Olyra.*
74. Spikelets paired. ..... 100. *Hyparrhenia.*
70. Spikelets with perfect florets.
75. Inflorescence a raceme or spike.
76. Inflorescence a raceme. ..... 51. *Aegopogon.*
76. Inflorescence a spike. ..... 50. *Tragus.*
75. Inflorescence a panicle.
77. Glumes lacking. ..... 65. *Leersia.*
77. Glumes present.
78. Spikelets paired.
79. One spikelet perfect, the other staminate or neuter. ..... 41. *Lycurus.*
79. One spikelet perfect and sessile, the other pistillate and pedicellate. ....97. *Eriochrysis.*
78. Spikelets not paired.
80. Spikelets awnless. ..... 20. *Orthoclada.*

80. Spikelets awned.
    81. Inflorescence not interrupted. ..... 39. *Alopecurus.*
    81. Inflorescence interrupted. ..... 40. *Polypogon.*
69. Spikelets with 2 or more florets.
    82. Fertile floret below the sterile floret.
        83. Inflorescence a panicle; spikelets usually solitary. ..... 20. *Orthoclada.*
        83. Inflorescence of pectinately arranged spikes; spikelets not solitary. ..... 62. *Bouteloua.*
    82. Fertile floret above the sterile floret.
        84. Spikelets subtended by bristles, these separate, or at least partially united and forming a bur.
            85. Spikelets and bristles forming a bur. ..... 93. *Cenchrus.*
            85. Spikelets and bristles not forming a bur.
                86. Bristles persistent. ..... 91. *Setaria.*
                86. Bristles deciduous. ..... 92. *Pennisetum.*
        84. Spikelets not subtended by bristles.
            87. First glume absent.
                88. Spikelets without unisexual florets.
                    89. Spikelets not unilateral on the rachis. .... 71. *Leptocoryphium.*
                    89. Spikelets unilateral on the rachis.
                        90. Second glume and fertile lemma turned away from the rachis. .... 80. *Axonopus.*
                        90. Second glume and fertile lemma turned toward the rachis (first glume rarely present but minute).
                            91. Fruit flexible, cartilaginous, usually dark. ..... 73. *Digitaria.*
                            91. Fruit rigid, chartaceous, usually light. ..... 81. *Paspalum.*
                88. Spikelets with unisexual florets; pistillate and staminate florets in separate spikelets. ..... 94. *Olyra.*
            87. First glume present.
                92. Second glume ventricose and uncinately spiny at maturity. ..... 75. *Pseudechinolaena.*
                92. Second glume not ventricose nor uncinately spiny at maturity.
                    93. Spikelets paired, with 1 spikelet sessile, the other pedicellate.
                        94. Both spikelets, or only 1, with a perfect floret.
                            95. Both spikelets with a perfect floret.

96. Spikelets awnless. .... 96. *Saccharum.*
96. Spikelets awned. .. 98. *Erianthus.*
95. One spikelet with a perfect floret.
97. Perfect spikelet pedicellate. .... 104. *Trachypogon.*
97. Perfect spikelet sessile.
98. Disarticulation immediately below glumes. .... 99. *Andropogon.*
98. Disarticulation not immediately below glumes, but in rachis or pedicel.
99. First glume concealing the rest of the spikelet. .... 107. *Hackelochloa.*
99. First glume not concealing spikelet.
100. Inflorescence a solitary raceme (occasionally more than 1).
101. Spikelets awned. .. .... 103. *Heteropogon.*
101. Spikelets awnless.
102. Glumes pubescent, hirsute or villous. .... 105. *Elyonurus.*
102. Glumes glabrous. .... 106. *Manisuris.*
100. Inflorescence paniculate.
103. Pedicellate spikelet staminate. .... 101. *Sorghum.*
103. Pedicellate spikelet reduced to a pedicel. .... 102. *Sorghastrum.*
94. Neither spikelet with a perfect floret. ..... 108. *Tripsacum.*
93. Spikelets not paired, or if in pairs, not

with 1 spikelet sessile and the other pedicellate.

104. Inflorescence of solitary, or mostly so, racemes.

105. Spikelets paired. ..... 74. *Thrasya.*

105. Spikelets unpaired, but sometimes in 2 rows.

106. Spikelets (pistillate only) sunken in rachis. ..... 108. *Tripsacum.*

106. Spikelets not sunken in rachis.

107. Sterile lemma and second glume with tufts of hairs. .. .. 77. *Mesosetum.*

107. Sterile lemma and second glume glabrous. ..... 79. *Brachiaria.*

104. Inflorescence a panicle.

108. Spikelets paired.

109. Glumes awnless.

110. Sterile lemma and second glume alike. ..... 72. *Trichachne.*

110. Sterile and fertile lemmas alike, unlike second glume. ..... 95. *Imperata.*

109. Glumes awned or mucronate.

111. Ring-callus on rachilla at base of spikelet. ..... 78. *Eriochloa.*

111. Ring-callus absent from rachilla. ..... 89. *Oplismenus.*

108. Spikelets unpaired or clustered.

112. Spikelets clustered.

113. Spikelets awnless, not plano-convex. .... 86. *Hymenachne.*

113. Spikelets awned, plano-convex. ..... 90. *Echinochloa.*

112. Spikelets unpaired.

114. Spikelets placed obliquely on pedicels. ..... 84. *Lasiacis.*

114. Spikelets not placed obliquely on pedicels.

115. Spikelets awnless.

116. Second glume inflated, saccate. .... 85. *Sacciolepis.*

116. Second glume not inflated nor saccate.
117. Lemma stipitate. .. .... 83. *Ichnanthus.*
117. Lemma not stipitate.
118. Spikelets with 2 perfect florets, subglobose. .... 88. *Isachne.*
118. Spikelets with 1 perfect floret, not subglobose.
119. First glume as long as spikelet. .... 87. *Homolepis.*
119. First glume not as long as spikelet. .... 82. *Panicum.*
115. Spikelet awned or mucronate.
120. Ring-callus on rachilla at base of spikelet. ..... 78. *Eriochloa.*
120. Ring-callus absent.
121. Glumes very unequal. .... 76. *Rhynchelytrum.*
121. Glumes equal or subequal. .... 89. *Oplismenus.*

1. Inflorescences, at least the pistillate, surrounded by a hard bony involucre. ..... 109. *Coix.*

1. **Arthrostylidium** Rupr.

Arthrostylidium racemiflorum Steud. Syn. Pl. Glum. **1**: 336 (1854). Perennial, climbing or sprawling, to 5 m. long; main axis to 5 mm. thick, the fertile branches clustered at the nodes. Leaf-blades linear, to 6 mm. wide, often short-pubescent above and beneath, with scattered longer hairs. Inflorescence racemose, the racemes to 8 cm. long, the

rachis pubescent. Spikelets few-flowered, the lowest lemmas empty; disarticulation above the glumes. Lemma to 6 mm. long, 7-nerved, awned, the awn 1-2 mm. long. Palea longer than the lemma, the keels ciliolate. SANTA CRUZ: ICHILO: Río Yapacani, 350 m., *Steinbach* 7587 (GH).

This collection is a sterile sheet identified by Mrs. Agnes Chase as "probably" this species.

2. **Arundinaria** Michx.

Arundinaria Herzogiana Henrard in Meded. Rijks Herb. Leiden, no. 40: 75 (1921). Shrubby perennial. Leaf-sheaths long-fimbriate at the apex, the fimbriae to 2 cm. long; blades lanceolate, acute, to 25 cm. long and 3 cm. wide, glaucous, glabrous above, scabrous and more or less hirtellous beneath. Inflorescence a terminal, lax, racemose panicle to 3 dm. long, hardly, if at all, exserted from the uppermost leaves, the pubescent branches distant on the axis. Spikelets 2-3 cm. long, pedicellate, about 5-flowered; disarticulation above the glumes. First glume absent; second glume about 1 mm. long, 3-nerved, the margin ciliate, with a 3-4 mm. awn. Sterile lemmas 2, awned, the first pubescent on the upper portion. Fertile lemmas to 1 cm. long, 7-nerved, shortly puberulent, with a 2-3 mm. awn. LA PAZ: INQUISIVI [?]: Río Saujana, 3200 m., *Herzog* 2396 (US; type-number).

There is no information available as to the height of the plant.

3. **Chusquea** Kunth

Shrubby perennials, sometimes low-growing, or the culms 2-7 m. long, slender to stout, woody. Leaf-blades lanceolate to linear-lanceolate, 2-18 cm. long, acute, disarticulating from the persistent sheaths. Fertile branches loosely to densely fascicled at the nodes, or the inflorescences terminal on the culms; inflorescence an open to rather crowded panicle, or spicate in appearance, spikelets few to numerous in an inflorescence. Spikelets pedicellate, small; glumes present or absent; sterile lemmas 2, below 1 perfect floret; disarticulation above the glumes.

a. Glumes absent or less than 0.5 mm. long.
  b. Glumes absent. ..... 2. *C. delicatula.*
  b. Glumes present, less than 0.5 mm. long.
    c. Culms 2-7 m. long, 1 cm. thick; fertile stems densely clustered at nodes, with numerous spikelets. ..... 4. *C. peruviana.*
    c. Culms much shorter, 4 mm. thick; fertile stems few at nodes, spikelets few. ..... 1. *C. uniflora.*

a. Glumes present, 1 mm. long, or more.
  d. Rachis, branches and pedicels glabrous. ..... 5. *C. serrulata.*
  d. Rachis, branches and pedicels puberulent.

e. Spikelets mostly distinctly pedicellate, the panicle somewhat open; lemmas distinctly awned. ..... 6. *C. scandens.*
e. Spikelets rarely pedicellate, the inflorescence densely spicate in appearance, lemmas shortly mucronate. ..... 3. *C. spicata.*

1. **Chusquea uniflora** Steud. Syn. Pl. Glum. **1:** 327 (1854). *C. longipendula* O. Ktze. Rev. Gen. 3(2): 348 (1898). Leaf-blades pubescent or glabrous beneath. Spikelets to 7 mm. long, sterile and fertile lemmas strongly carinate, the keel prolonged as a distinct scabrous awn. LA PAZ: NOR YUNGAS: Bella Vista, *Hitchcock* 22753 (GH).

2. **C. delicatula** Hitchcock in Contrib. U. S. Nat. Herb. **23:** 309 (1927). Leaf-blades glabrous beneath. Spikelets 5-6 mm. long; sterile lemmas ending in a short subulate point. LA PAZ: NOR YUNGAS: Bella Vista, *Hitchcock* 22748 (GH; type-number).

3. **C. spicata** Munro in Trans. Linn. Soc. **26:** 60 (1868). Leaf-blades glabrous beneath, the margins densely ciliolate. Spikelets about 6 mm. long. LA PAZ: LARECAJA: Mapiri, *Rusby* 196 (Hitchcock).

4. **C. peruviana** E. G. Camus, Bamb. Monogr. 88, t. 53B (1913). Leaf-blades sparsely pilose beneath, the apex long-setaceous. Spikelets glabrous, to 10 mm. long, the lemmas shortly mucronate. LA PAZ: NOR YUNGAS: Bella Vista, *Hitchcock* 22746 (GH), 22744 (GH).

5. **C. serrulata** Pilger in Engler, Bot. Jahrb. **25:** 719 (1898). Leaf-blades glabrous beneath. Spikelets about 7 mm. long, the lemmas mucronate. LA PAZ: MURILLO: La Paz, *Rusby* 10 (Hitchcock); NOR YUNGAS: Bella Vista, *Hitchcock* 22750 (GH); Coroico, *Bang* 2348 (GH); SUR YUNGAS: Colaya, 1810 m., *Mexia* 4298 (GH).

6. **C. scandens** Kunth, Syn. Pl. Aequin. **1:** 254 (1822). *C. quitensis* var. *patentissima* Hack. in Fedde, Rep. Sp. Nov. **6:** 161 (1908). Leaf-blades somewhat pilose beneath, the apex setaceous. Spikelets about 8 mm. long. LA PAZ: NOR YUNGAS: Unduavi, 3300 m., *Buchtien* 4185 (GH); Bella Vista, *Hitchcock* 22747 (GH).

4. Bromus L.

Annual or perennial, the culms erect or spreading, sometimes prostrate. Inflorescence a terminal racemose panicle, the spikelets several- to many-flowered, the puberulent rachilla disarticulating above the unequal glumes, the lemmas awned or awnless, glabrous or pubescent, the uppermost floret a sterile lemma or a rudiment.

a. Glumes scabridulous to scabrous, but not puberulent nor pubescent.
b. Lemmas pubescent, awn twisted. ..... 1. *B. Trinii.*
b. Lemmas not pubescent or only very slightly so, awn not twisted.
c. Leaf-blades to 1 cm. wide; lemma tuberculate-scabridulous. ..... 2. *B. segetum.*
c. Leaf-blades to 5 mm. wide; lemma not tuberculate-scabridulous. ..... 3. *B. catharticus.*
a. Glumes puberulent to pubescent.

d. Inflorescence-rachis and pedicels short-pubescent. .... 4. *B. lanatus.*
d. Inflorescence-rachis and pedicels scabridulous but not pubescent. ..... 5. *B. pitensis.*

1. **Bromus Trinii** Desv. in Gay, Fl. Chile, **6:** 441 (1853). Annual, to 6 dm. high, the culms, inflorescence-rachis and pedicels glabrous. Leaves sparsely pilose on the sheaths, the blades pilose, at least when young. Spikelets to a little over 2 cm. long, about 7-flowered, the uppermost floret reduced to a narrow sterile lemma. First glume about 1.1 cm. long, 1-nerved; second glume about 1.3 cm., 3-nerved, the nerves green. Lowest lemma about 1 cm. long, 2-toothed, the teeth very evident, the awn about 1.4 cm. long. Palea about 9 mm. long, bicarinate, the keels ciliate near the apex. LA PAZ: LARECAJA: Sorata, *Mandon* 1370 (US).

2. **B. segetum** HBK. Nov. Gen. & Sp. **1:** 151 (1816). Perennial, the panicle to 2 dm. long, culms, rachis and pedicels glabrous. Leaves glabrous, the blades scabridulous beneath. Spikelets to 1.5 cm. long, 2-4-flowered, the uppermost floret reduced to a rudiment. First glume 5 mm. long, 1-nerved, the second glume to 8 mm. long, 3-nerved. Lowest lemma about 1.2 cm. long, shortly bidentate, awn about 2 mm. long. Palea as long as lemma, bidentate, bicarinate, the keels ciliolate. COCHABAMBA: CHAPARE: La Aduana, 3000 m., *Steinbach* 9533 (GH).

3. **B. catharticus** Vahl, Symbol. Bot. **2:** 22 (1791). *B. unioloides* HBK. Nov. Gen. & Sp. **1:** 151 (1816). *B. angustatus* Pilger in Engler, Bot. Jahrb. **25:** 719 (1898). Annual or perennial, the culms glabrous, the rachis and pedicels scabridulous, the open panicles to 3 dm. long. Leaf-sheaths glabrous, blades scabridulous beneath. Spikelets about 2.5 cm. long, with up to 9 florets, the uppermost a rudiment. First glume to 9 mm. long, 3-nerved, the second glume to 1 cm., 5-nerved. Lowest lemmas to 1.4 cm. long, not toothed, awn about 5 mm. long, upper lemmas awnless. Palea to 1.3 cm. long, bidentate, bicarinate, the keels long-ciliate. LA PAZ: MURILLO: La Paz, 3700 m., *Buchtien* 8533 (GH). COCHABAMBA: CERCADO: Valle de Cochabamba, *Steinbach* 8798 (GH). TARIJA: CERCADO: Calderillo, 3200 m., *Fiebrig* 2904 (GH).

Very variable in size, spikelet-length and awn-length. Many lemmas awnless.

4. **B. lanatus** HBK. Nov. Gen. & Sp. **1:** 150 (1816). *B. Pflanzii* Pilger in Engler, Bot. Jahrb. **49:** 189 (1912). Perennial, to 6 dm. high, the leaf-blades somewhat villous. Panicle very lax, 10-20 cm. long. Spikelets to 2 cm. long, with about 6 florets, the uppermost a rudiment. First glume to 1 cm. long, 3-nerved, the second glume to 1.3 cm. long, 5-nerved. Lowest lemmas about 1.2 cm. long, densely villous along the margins, shortly bidentate, the awn 4-5 mm. long. Palea about 1 cm. long, bicarinate, the keels ciliate. LA PAZ: INGAVI: Comanche, *Asplund* 6459 (Hitchcock). TARIJA: CERCADO: Calderillo, 3200 m., *Fiebrig* 2904 in part (GH).

5. **B. pitensis** HBK. Nov. Gen. & Sp. **1:** 152 (1816). *B. Buchtienii*

Hack. in Fedde, Rep. Sp. Nov. 11: 30 (1912). Perennial, to 1.5 m. high. Leaf-blades glabrous or somewhat pilose. Panicles lax, up to 3 dm. long. Spikelets to 2.5 cm. long, up to 9-flowered. First glume about 6 mm. long, 1-nerved, the second glume about 9 mm. long, 3-nerved. Lowest lemmas to 1.3 cm. long, bidentate, sparsely pubescent or villous on the lower half, the awn 4 mm. long. Palea about 1.1 cm. long, bidentate, bicarinate, the keels ciliate. Anthers villous at base. LA PAZ: LARECAJA: Sorata, 2600-2800 m., *Mandon* 1365 (GH); MURILLO: La Paz, 3800 m., *Buchtien* 518 (GH).

5. **Brachypodium** Beauv.

Brachypodium mexicanum Link, Hort. Berol. 1: 41 (1827). Perennial, straggling, to 6 dm. high. Leaves glabrous, the blades usually much shorter than the inflorescence, scabridulous beneath, acute, to 1.2 cm. wide, usually narrower. Inflorescence a solitary, terminal raceme of a few distant spikelets, these at first appressed, ultimately spreading or deflexed, the raceme to 10 cm. long. Spikelets to 2.5 cm. long (excluding the awns), subterete, to 10-flowered, the glabrous or upper portion and downward along the lateral nerves, awned, the minutely puberulent rachilla disarticulating above the glumes; glumes unequal, the first about 6 mm. long, the second to 7 mm. long, both awnless; lemmas about 9 mm. long, 5-7-nerved, puberulent on the awn about 4-6 mm. long, the 2 uppermost florets reduced and sterile; palea as long as the lemma, bicarinate, the keels densely ciliate. LA PAZ: LARECAJA: Sorata, *Holway* 544 (US). COCHABAMBA: CERCADO: Cochabamba, Tequiña, *Hitchcock* 22855 (US), *Holway* 409 (US).

6. **Festuca** L.

Annual or perennial, of varying heights. Leaves flat or involute, shorter than or exceeding the inflorescence. Inflorescence a terminal racemose panicle, the spikelets few- to several-flowered, the puberulent rachilla disarticulating above the unequal or subequal glumes. Lemmas firm to somewhat indurate in texture, awned, awn-tipped or awnless, the uppermost reduced and sterile.

a. First glume 1 mm. long or less; lemmas ciliate at apex, tuberculate-scabridulous. ..... 1. *F. megalura.*

a. First glume at least 1.5 mm. long; lemmas not ciliate at apex, not tuberculate-scabridulous.

b. Lemmas with awns at least 5 mm. long. ..... 2. *F. ulochaeta.*

b. Lemmas awn-tipped (about 1 mm.) or awnless.

c. Rachis and pedicels scabrid to pubescent; lemmas not pubescent along margin.

d. Lemmas (at least some) awn-tipped.

e. Leaf-blades flat. ..... 3. *F. procera.*

e. Leaf-blades involute and pungent.

f. Lemmas glabrous or puberulous at apex. .. 4. *F. sublimis.*

f. Lemmas scabridulous at apex. ..... 5. *F. rigescens.*
d. Lemmas awnless ..... 7. *F. dolichophylla.*
c. Rachis and pedicels glabrous; lemmas pubescent along margin. ..... 6. *F. orthophylla.*

1. **Festuca megalura** Nutt. in Journ. Acad. Sci. Philad. (ser. 2) **1:** 188 (1848). Annual. Panicles narrow, usually over 10 cm. long, often exceeded by the uppermost flat glabrous leaf-blades. Spikelets (excluding awns) about 1 cm. long, with 4-5 florets. Glumes unequal, the first about 1 mm. long or less, the second, 2.5-3 mm. long. Lowest lemmas to 5 mm. long with a 1.5 cm. scabrid awn, upper lemmas long-ciliate near the apex, most lemmas tuberculate-scabridulous (at least in dried material). Palea as long as lemma, bicarinate, the ciliate keels nearly marginal. LA PAZ: LARECAJA: vic. Sorata; Ullonciliate, 2650-2900 m., *Mandon* 1363 (GH). COCHABAMBA: CHAPARE: Incatiji, 2650-2900 m., *Mandon* 1363 (GH); CERCADO: south side of Mt. chaca 2250 m., *Steinbach* 9498 (GH); CERCADO: south side of Mt. Tunari, 3300 m., *Steinbach* 9850 (GH). POTOSÍ: CERCADO: Potosí, *Cárdenas* 203 (GH). TARIJA: CERCADO: Calderillo, 3200 m., *Fiebrig* 3159 (GH).

2. **F. ulochaeta** Steud. Syn. Pl. Glum. **1:** 305 (1854). Perennial, up to 1 m. high, the culms, rachis and pedicels scabrid. leaf-blades sometimes exceeding the inflorescence, to 5-8 mm. wide, scabrid beneath. Panicle fairly lax, to 2 dm. long. Spikelets (excluding awns) about 8 mm. long, 4-5 flowered. Glumes 1.5 and 2.5 mm. long. Lowest lemmas 5-6 mm. long, convex to rounded, 3-nerved, the central nerve scabridulous at apex, awns very filiform, flexible, 5-8 mm. long. Palea as long as lemma, bicarinate, the keels ciliolate. LA PAZ: MURILLO: Unduavi, *Buchtien* 6415 (Hitchcock). COCHABAMBA: CHAPARE: Incachaca, 2300 m., *Steinbach* 8976 (GH).

3. **F. procera** HBK. Nov. Gen. & Sp. **1:** 154 (1816). *F. Fiebrigii* Pilger in Engler, Bot. Jahrb. **37:** 510 (1906). Perennial, to 1-2 m. high, the panicle to 3 dm. long; rachis and pedicels short-pubescent, leaf-blades narrow, flat or somewhat folded, scabrid beneath. Spikelets about 8 mm. long, 3-5-flowered. Glumes 4 mm. and 5 mm. long, the first 1-nerved, the keel scabrid near the apex, the second 3-nerved, at least the keel scabrid above. Lowest lemmas to 6-7 mm. long, rounded, several-nerved, scabrid to scabrid-puberulent, especially on the upper portion, awn-tipped. Palea as long as lemma, bicarinate, the keels ciliolate, bidentate, the apex puberulous. TARIJA: AVILES: Pinos, 2800 m., *Fiebrig* 3117 (GH; type number of *F. Fiebrigii*), 3118 (GH).

4. **F. sublimis** Pilger in Engler, Bot. Jahrb. **25:** 718 (1898). Perennial, caespitose, to 1 m. high, the involute, glabrous to scabrid, pungent leaf-blades sometimes exceeding the inflorescence. Panicle fairly lax, to 2.5 dm. long, rachis and pedicels scabrid to short-pubescent. Spikelets about 1 cm. long, 4-flowered (in most). Glumes 4 mm. and 5 mm. long, the second minutely ciliolate and sometimes

scabridulous. Lowest lemmas about 7 mm. long, awnless, the upper ones awn-pointed (1 mm.), glabrous to puberulous. Palea as long as lemma, bidentate, puberulent, bicarinate, the keels ciliate. LA PAZ: LARECAJA: vic. Sorata; Chilcani, *Mandon* 1362 bis (GH).

5. **F. rigescens** (Presl) Kunth, Rév. Gram. 1: suppl. XXXI (1830). Caespitose perennial, to 4 dm. high, leaf-blades involute, pungent, glabrous, sometimes exceeding the narrow 5-20 cm. panicle, the rachis and pedicels puberulent. Spikelets to 1.1 cm. long, about 4-flowered. Glumes 6 mm. and 7 mm. long, the second scabridulous near the apex. Lowest lemmas to 8 mm. long, rounded, the apex scabridulous, sometimes slightly 2-toothed, awnless to awn-pointed. Palea shorter than lemma, puberulous on both surfaces, bicarinate, the keels ciliolate. LA PAZ: YUNGAS, *Bang* 173 (GH); MURILLO: Palca, 3700 m., *Hitchcock* 22560 (GH). POTOSÍ: CERCADO: Potosí, 4000 m., *Cárdenas* 208 (GH).

6. **F. orthophylla** Pilger in Engler, Bot. Jahrb. **25:** 717 (1898). *F. orthophylla* var. *boliviana* Pilger in Engler, Bot. Jahrb. **37:** 508 (1906). Caespitose perennial, to 5 dm. high, leaves involute, glabrous, firm, pungent, often equaling or exceeding the inflorescence. Panicle narrow, the branches ascending, rachis and pedicels glabrous. Spikelets about 1 cm. long, 4-6-flowered. Glumes about equal, 6 mm. long, the first 1-nerved, the nerve scabrid, margins slightly ciliate, with an apical tuft of hairs, the second 3-nerved, broader than the first but otherwise similar. Lowest lemmas about 7 mm. long, awnless, pubescent along the margin. Palea as long as lemma, pubescent at apex, bicarinate, the keels ciliate, at least on the uppper half. TARIJA: AVILES: Puna Patanca, 3700 m., *Fiebrig* 3192 (GH; type-number of *F. orthophylla* var. *boliviana*).

7. **F. dolichophylla** Presl, Rel. Haenk. **1:** 258 (1830). *F. laeteviridis* Pilger in Engler, Bot. Jahrb. **37:** 510 (1906). *F. Buchtienii* Hack. in Fedde, Rep. Sp. Nov. **6:** 160 (1908). *F. Pflanzii* Pilger in Engler, Bot. Jahrb. **49:** 188 (1912). Caespitose perennial, 4-10 dm. high, the involute pungent leaves glabrous or scabrid, occasionally equaling the inflorescence. Panicle narrow, the branches appressed or spreading, to 15 cm. long, the rachis and pedicels scabridulous. Spikelets to 1.1 cm. long, 3-4-flowered. Glumes unequal, the first to 4.5 mm. long, apically scabrid, the second to 7 mm. long, ciliolate at base, apically scabrid. Lowest lemmas to 7 mm. long, awnless, scabrid toward apex, but otherwise glabrous. Palea as long as lemma or longer, bidentate, bicarinate, the keels minutely ciliolate. LA PAZ: LARECAJA: vic. Sorata; Millipaya, 3700-4200 m., *Mandon* 1361 (GH); MURILLO: Palca, 3700 m., *Hitchcock* 22568 (GH); La Paz, 3300 m., *Bang* 33 (GH), 4100 m., *Buchtien* 428 (GH). COCHABAMBA: CERCADO: Cerro Molle-Molle, *Steinbach* 4093 (GH), 3800 m., *Steinbach* 4062 (GH); AYOPAYA: Tabacruz, 4200 m., *Steinbach* 9760 (GH); south side of Mt. Tunari, 3600 m., *Steinbach* 9787 (GH), 9784 (GH). POTOSÍ: SUR CHICHAS: Tupiza, 2700 m., *Fiebrig* 2955 (GH; type-number of *F. laeteviridis*).

7. **Aphanelytrum** Hack.

Aphanelytrum procumbens (Hack.) Hack. in Oesterr. Bot. Zeitschr. **52:** 13 (1902). A straggling perennial, culms decumbent, sometimes stoloniferous, to 8 dm. high. Leaves glabrous, not scabridulous, much shorter than the inflorescence, the short acute blades about 3 mm. wide. Inflorescence a lax racemose panicle up to 2 dm. long, the very slender branches distant and bearing 2-3 spikelets at their ends. Spikelets about 1.2 cm. long, pedicellate, 2-flowered, the naked rachilla disarticulating above the glumes, the second floret distant from the first; glumes greatly reduced, minute; lemmas to 7 mm. long, long-acute but not awned, more or less hyaline, several-nerved, the nerves green; palea similar to the lemma but shorter, 1-nerved, the nerve green. LA PAZ: MURILLO: Unduavi, 3300 m., *Buchtien* 4268 (US); NOR YUNGAS: Bella Vista, *Hitchcock* 22756 (US).

8. **Puccinellia** Parl.

Perennials, low-growing, the more or less decumbent culms up to 20 cm. high. Leaves glabrous, short, very narrow, the uppermost blade on a culm equaling or sometimes exceeding the inflorescence and often enveloping its base. Inflorescence a short, dense, racemose panicle up to 12 cm. long, the branches erect, appressed, the pedicels often (or usually) short, thick, sulcate. Spikelets 2-3-flowered, all florets perfect, glumes present, the naked rachilla disarticulating above the glumes; lemma rounded, the nerves obscure, glabrous, but sometimes puberulent at the base, awnless.

Spikelets about 2 mm. long; lemma about 1 mm. long. .... 1. *P. parvula.*
Spikelets 4-5 mm. long; lemma about 2.5 mm. long. .... 2. *P. oresigena.*

1. **Puccinellia parvula** Hitchc. in Contrib. U. S. Nat. Herb. **24:** 325 (1927). Spikelets 2-3-flowered. Glumes unequal, the first about 0.5 mm. long, the second, 1 mm. long. Lemmas elliptic-oblong, the apex obtuse or lacerate; palea about as long as the lemma. POTOSÍ: SUR CHICHAS: Atocha, 3300 m., *Hitchcock* 22878 (US; type).

2. **P. oresigena** (Phil). Hitchc. in Contrib. U. S. Nat. Herb. **24:** 326 (1927). Spikelets 3-flowered. Glumes unequal, the first about 1 mm. long, the second, 1.5 mm. long. Lemmas acute. POTOSÍ: SUR CHICHAS: Atocha, *Hitchcock* 22879 (GH).

9. **Amphibromus** Nees

Amphibromus scabrivalvis (Trin.) Swallen in Amer. Journ. Bot. **18:** 413 (1931). A rhizomatous perennial, the culms erect (the base sometimes decumbent), to 1 m. or more in height. Leaves glabrous, the lowest blade to 40 cm. long, the uppermost reduced, 2-6 mm. wide. Inflorescence a rather lax racemose panicle to 20 cm. long, the slender branches often spreading or drooping. Spikelets pedicellate, up to 7-flowered, the florets distant, the uppermost floret sterile, to 1.5 cm.

long (excluding the awns), the rachilla unilaterally short-villous, with an apical ring of hairs below each floret, disarticulating above the glumes. Glumes unequal, the first about 4 mm. long, the second, 5 mm. long, the apex erose. Lemmas about 7 mm. long, bifid to the middle or below, the 1.2 cm. twisted geniculate awn arising from the base of the sinus, up to 9-nerved, scabrid, the apices erose; palea shorter than the lemma, bicarinate. LA PAZ: MURILLO: La Paz, *Buchtien* 6422 (US).

10. **Poa** L.

Annual or perennial, one species dioecious. Culms usually but not always exceeding the leaves. Leaf-blades flat or involute, usually scabridulous beneath. Inflorescence a terminal racemose panicle, narrow and condensed or more open and spreading, the rachis and pedicels glabrous, puberulent or scabridulous, sometimes sparsely so. Spikelets 2-6-flowered, the glumes usually unequal, the glabrous or puberulent rachilla disarticulating above the glumes; fertile lemmas below the sterile lemma or rudiment.

a. Plants dioecious. ..... 1. *P. Buchtienii.*
a. Plants not dioecious.
  b. Dwarf plants, about 4 cm. high; glumes and lemmas subquadrate. ..... 3. *P. humillima.*
  b. Plants taller; glumes and lemmas not subquadrate.
    c. Rachis and pedicels glabrous.
      d. Spikelets to 6 mm. long, 4-5-flowered; annual. .... 9. *P. annua.*
      d. Spikelets to 3 mm. long, 3-flowered; perennial. ..... 10. *P. denticulata.*
    c. Rachis and pedicels puberulent or scabridulous.
      e. Spikelets subquadrate, as broad as long. ..... 5. *P. Hieronymi.*
      e. Spikelets longer than broad (but note no. 11).
        f. Spikelets 2-flowered. ..... 12. *P. candamoana.*
        f. Spikelets almost always more than 2-flowered.
          g. Lemmas not villous on any part.
            h. First glume about 2.5 mm. long. ..... 6. *P. Lilloi.*
            h. First glume about 4.5 mm. long. ..... 4. *P. gymnantha.*
          g. Lemmas with at least basal villosity.
            i. Rachilla puberulent. ..... 8. *P. asperiflora.*
            i. Rachilla glabrous.
              j. Spikelets to 7 mm. long, often almost as broad as long. ..... 11. *P. horridula.*
              j. Spikelets 4-5 mm. long, definitely longer than broad.
                k. Glumes equal or subequal. ..... 7. *P. pratensis.*
                k. Glumes unequal. ..... 2. *P. scaberula.*

1. **Poa Buchtienii** Hack. in Fedde, Rep. Sp. Nov. **11:** 29 (1912). *P. Buchtienii* var. *subacuminata* Hack. in Fedde, Rep. Sp. Nov. **11:** 30 (1912). Perennial, to 8 dm. high, the leaf-blades flat, to 3 mm. wide.

Rachis and pedicels scabrid. Staminate spikelets: about 5 mm. long, 3-5-flowered, the rachilla glabrous. First glume 2.5 mm. long, 1-nerved, the nerves scabrid, at least on the upper portion, the second glume about 3.5 mm. long, broader than the first, obscurely 3-nerved, the keel scabridulous. Lowest lemmas about 3.5 mm. long, obscurely nerved, the mid-nerve scabridulous on the upper part, the apex erose. Palea 3 mm. long, the 2 keels ciliolate. Pistillate spikelets: about 6-7 mm. long, 5-flowered, the rachilla glabrous. First glume about 2.5 mm. long, 1-nerved, the keel scabridulous, the second glume 3 mm. long, 3-nerved, the keel scabrid. Lowest lemmas about 4.5 mm. long, densely long-pilose at base and on the lower half of the keel, the apex erose to acute. Palea shorter than the lemma, the keels long-pilose below and ciliate above. LA PAZ: MURILLO: La Paz, 3700 m., *Buchtien* 2468 (GH); Palca, 3700 m., *Hitchcock* 22559 (GH), 22570 (GH).

One culm on the Gray Herbarium sheet of *Buchtien* 2468 bears staminate spikelets with the basal villosity of the pistillate spikelets.

2. **P. scaberula** Hook. f. Fl. Antarct. 378 (1847). Annual, to 5 dm. high, the leaf-blades to 2 mm. wide and scabrid beneath, the rachis and pedicels densely scabrous. Spikelets to 4 mm. long, about 4-flowered, the rachilla glabrous. Glumes 2 and 2.5 mm. long, the keels scabrid. Lowest lemmas 2.5 mm. long, villous at base and halfway up the keel, the lateral nerves often somewhat villous basally. Palea much shorter than the lemma, the keels ciliate. LA PAZ: LARECAJA: vic. Sorata; Lancha de Cochipata, 3000-3700 m., *Mandon* 1336 (GH); MURILLO: La Paz, 3670 m., *Buchtien* (GH).

3. **P. humillima** Pilger in Engler, Bot. Jahrb. **37:** 378 (1906). Very dwarf, caespitose perennial, the leaf-blades hardly 2 cm. long, involute, glabrous, the panicle not over 1 cm. long, rachis and pedicels puberulent. Spikelets to 5 mm. long, 3-4-flowered, the rachilla glabrous. Glumes equal, 3.5 mm. long, subquadrate, apex coarsely and erosely toothed, obscurely 3-nerved. Lemmas about 4.5 mm. long, subquadrate, 5-nerved, the apex erosely toothed. Palea shorter than lemma, bicarinate. LA PAZ: LARECAJA: vic. Sorata; near Anilaya, 4500 m., *Mandon* 1353 (GH).

4 **P. gymnantha** Pilger in Engler, Bot. Jahrb. **56**, Beibl. 123: 28 (1920). *P. perligulata* Pilger in Notizbl. **11:** 779 (1933). *P. gymnantha* var. *aperta* Pilger in Notizbl. **11:** 780 (1933). Caespitose perennial to 20 cm. high, leaf-blades flat or involute, glabrous, 5-10 cm. long, the panicles 3-7 cm. long, rachis and pedicels scabridulous-puberulent. Spikelets 5-7 mm. long, 2-3 (-4)-flowered. Glumes unequal, the first to 4.5 mm. long, 1-nerved, scabridulous at apex, the second to 5 mm. long, 3-nerved, scabridulous at apex. Lemmas acute to subacute, 5.5 mm. long, 5-nerved, the keel scabrid-ciliate, the rest

scabridulous. Palea as long as lemma, scabridulous, the 2 keels scabrid-ciliolate. LA PAZ: LARECAJA: vic. Sorata; Llachisani, 4200 m., *Mandon* 1348 (GH); Anilaya, 3500-4000 m., *Mandon* 1350 (GH), 3800-4200 m., *Mandon* 1351 (GH); MURILLO: vic. La Paz, 5000 m., *Mandon* 1352 (GH). COCHABAMBA: AYOPAYA: Tabacruz, 4200 m., *Steinbach* 9761 (GH).

5. **P. Hieronymi** Hack. in Oesterr. Bot. Zeitschr. **52**: 380 (1902). *P. myriantha* Hack. in Stuckert in Anal. Mus. Nac. Buenos Aires, **13**: 517 (1906). Perennial, to 2 m. high, leaf-blades scabrous, the flat blades 8-10 mm. wide, scabrous beneath, the very lax open panicle to 4 dm. long, the ultimate branches extremely filiform, the rachis and pedicels sparsely scabridulous. Spikelets subquadrate, to 5 mm. long and broad, 5-6-flowered, the rachilla glabrous. Glumes equal, about 5 mm. long, the first 1-nerved, the nerve scabrid, the margin scabrid-ciliolate, the second 3-nerved, the nerves scabrid. Lemmas acute, to 3.5 mm. long, the nerves scabrid, the margins ciliolate, a small tuft of tangled hairs at base of central nerve. Palea decidedly shorter than the lemma, the 2 keels ciliolate. COCHABAMBA: CHAPARE: Incachaca, 2700 m., *Steinbach* 8956 (GH), 2500-3000 m., *Steinbach* 9517 (GH).

6. **P. Lilloi** Hack. in Stuckert in Anal. Mus. Nac. Buenos Aires, **21**: 153 (1911). Perennial, 10-20 (-30) cm. high, leaves glabrous, the very narrow blades involute, panicle 2-4 cm. long, rachis and pedicels scabrid, sometimes sparsely so. Spikelets about 5 mm. long, about 4-flowered, rachilla glabrous to slightly puberulent. First glume 2.5 mm. long, 1-nerved, the keel scabrid, the second glume to 3 mm., 3-nerved, scabridulous. Lemmas to 3.5 mm. long, 3-5-nerved, scabridulous, especially on the nerves. Palea nearly as long as the lemma, the 2 keels ciliolate. POTOSÍ: SUR CHICHAS: Atocha, *Hitchcock* 22931 (Hitchcock).

The description given is based on an isotype, *Lillo* 5619 (GH).

7. **P. pratensis** L. Sp. Pl. 67 (1753). *P. boliviensis* Hack. in Fedde, Rep. Sp. Nov. **11**: 25 (1912). Rhizomatous perennial, to 5 dm. high. Leaf-blades to 3 mm. wide, glabrous or scabridulous beneath. Panicles to 10 cm. long, the rachis and pedicels scabridulous. Spikelets about 5 mm. long, 3-5-flowered. The rachilla glabrous or sparsely and minutely puberulent. Glumes subequal, about 3 mm. long, the keels scabridulous, the first 1-nerved, the second 3-nerved. Lowest lemmas about 3 mm. long, 5-nerved, the keel basally long-villous, the upper half scabrous, marginal nerves basally villous. Palea nearly as long as the lemma, the 2 keels ciliolate. LA PAZ: MURILLO: San Jorge, 3550 m., *Buchtien* 236 (GH).

8. **P. asperiflora** Hack. in Fedde, Rep. Sp. Nov. **11**: 28 (1912). *P. Pflanzii* Pilger in Engler, Bot. Jahrb. **49**: 187 (1912). Caespitose perennial to 5 dm. high, the involute leaf-blades sometimes exceeding

the inflorescence, scabrid. Panicles fairly open, generally 10 cm. or less in length, the rachis and pedicels scabridulous. Spikelets about 7 mm. long, 4-flowered, the rachilla puberulent. First glume about 3.5 mm. long, 1-nerved, the second glume about 5 mm. long, 3-nerved, the keel slightly scabridulous. Lowest lemmas about 5 mm. long, 5-nerved, the keel basally short-villous, with scattered pubescence on the lateral nerves. Palea about 4 mm. long, the keels ciliolate. LA PAZ: LARECAJA: vic. Sorata; Lacatia, 3360-4200 m., *Mandon* 1341 (GH); MURILLO: Pilaya, 4000 m., *Hitchcock* 22587 (GH).

9. **P. annua** L. Sp. Pl. 68 (1753). Annual, the leaf-blades to 3 mm. wide, sometimes scabridulous beneath, the panicles open, to 6 cm. long, the rachis and pedicels glabrous. Spikelets to 6 mm. long, 4-5-flowered, the rachilla glabrous to sparsely puberulent. First glume about 2.5 mm. long, 1-nerved, faintly scabridulous near the apex, the second glume 3 mm. long, 3-nerved. Lowest lemmas 3 mm. long, 5-nerved, the keel with few to many hairs at base and about halfway up, but not forming a basal cobweb. Palea nearly as long as lemma, bicarinate. LA PAZ: LARECAJA: vic. Sorata; Achacache, 2650-3950 m., *Mandon* 1335 (GH). COCHABAMBA: CERCADO: Cochabamba, 2600 m., *Steinbach* 8787 (GH); CHAPARE: Incachaca, 2250 m., *Steinbach* 9496 (GH). SANTA CRUZ: VALLEGRANDE: Cerro de San Mateo, Comarapa, 3400 m., *Steinbach* 8486 (GH).

10. **P. denticulata** Hack. in Fedde, Rep. Sp. Nov. **11**: 27 (1912). Perennial, to 25 dm. high, leaf-blades 2-3 mm. wide, scabrid beneath. Panicles lax, to 8 cm. long, primary branches whorled, rachis and pedicels glabrous. Spikelets 4 mm. long, 3-flowered. Glumes 2 and 2.5 mm. long, the first 1-nerved, the second, 3-nerved. Lowest lemmas to 3 mm. long, ovate, obtuse, the apex erosely toothed, 5-nerved, the basal hairs reaching about one-third the length of the lemma. Palea as long as the lemma, bidentate, the keels scabridulous. LA PAZ: MURILLO: Unduavi, 3200 m., *Buchtien* 2584 (US; type-number).

11. **P. horridula** Pilger in Engler, Bot. Jahrb. **37**: 506 (1906). *P. androgyna* Hack. in Fedde, Rep. Sp. Nov. **6**: 159 (1908). *P. dumetorum* Hack. in Fedde, Rep. Sp. Nov. **11**: 27 (1912). *P. dumetorum* var. *unduavensis* Hack. in Fedde, Rep. Sp. Nov. **11**: 27 (1912). Perennial, to 1-1.5 m. high, leaf-blades to 8 mm. wide, scabridulous beneath. Panicle to 2 dm. long, the rachis and pedicels scabridulous. Spikelets to 7 mm. long, often about as broad as long, 4-5-flowered, the rachilla glabrous. First glume to 2.5 mm. long, 1-nerved, the nerve scabridulous, the second to 3 mm. long, 3-nerved, the nerves scabridulous. Lowest lemmas to 3.5 mm. long, 5-nerved, pilose on lower half of keel and along lower marginal nerves, the keel scabridulous on upper half. Palea as long as the lemma, the keels ciliate. LA PAZ: LARECAJA: vic. Sorata; Cochipata, 2700-3900 m., *Mandon* 1339 (GH); MURILLO: La Paz, *Buchtien* 846 (GH; type-number of *P. androgyna*), 3800 m., *Buchtien* 168 (GH); Unduavi, 3200 m., *Buchtien* 2583 (GH;

type-number of *P. dumetorum* var. *unduavensis*); NOR YUNGAS: Bella Vista, *Hitchcock* 22754 (GH).

12. **P. candamoana** Pilger in Engler, Bot. Jahrb. **37:** 381 (1906). Perennial, leaf-blades to 3 mm. wide, scabridulous beneath. Panicle to 15 cm. long, but usually much shorter, rachis and pedicels scabrid. Spikelets to 5 mm. long, 2-flowered, the rachilla sparsely villous. Glumes 3 and 4 mm. long, acute, the second much broader than the first. Lowest lemmas about 4 mm. long, villous on the lower half, the first floret sometimes not perfect but staminate. Palea shorter than the lemma, the keels ciliate. LA PAZ: MURILLO: La Paz, 3800 m., *Buchtien* 8536 (GH); NOR YUNGAS: Pongo, 3640 m., *Hitchcock* 22769 (GH).

Errata: Volume 67

p. 351 line 22 *Daura* should read *Datura*
p. 356 line 12 *Gleichena* should read *Gleichenia*
p. 368 Fig. 4 Caption should read Mean temperature for January in °F, (after Hare 1952)
p. 372 line 27 *sessiliflora* should read *sessilifolia*
p. 373 line 13 *macrocarpa* should read *macrocarpon*
p. 409, 411 running head *thyoites* should read *thyoides*

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JOURNAL OF THE
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Vol. 68 April-June, 1966 No. 774

NEW DATA ON NORTH AMERICAN OAK FERNS, GYMNOCARPIUM

WARREN H. WAGNER, JR.[1]

The oak ferns, *Gymnocarpium* Newman, include few taxa. Except for one or more separate and endemic elements in eastern Asia (cf. Pichi-Sermolli, 1965. p. 148), there are only two basic species over most of the circumboreal range. Nevertheless, there are controversial points regarding both the generic treatment and the species taxonomy. The common oak fern, *Gymnocarpium dryopteris* (L.) Newman has broadly triangular leaf blades with the axes so sparsely glandular that they are usually designated as "glabrous." The "limestone" oak fern, *G. robertianum* (Hoffm.) Newman, is far rarer and more sporadic in most of its range. It has narrower leaf blades, and the blade axes (and the lamina) are densely glandular. Both of these ferns are variable, both in habitat and morphology. Dwarfed plants of *G. robertianum*, especially those growing on dryish rock cliffs, may tend to mimic the leaf outline of *G. dryopteris*. Fully developed, however, the characteristics of

[1]Research supported by National Science Foundation Grant GB-2025. I wish to acknowledge the aid of Miss Sandra Smith and Mrs. Katherine Lim Chen, and the suggestions of Doctors E. T. Wherry, Eric Hultén, and Conrad V. Morton. The following herbaria kindly lent materials: Cranbrook Institute of Science, Gray Herbarium, Missouri Botanical Garden, U. S. National Museum, and the Naturhistoriska Riksmuseet, Stockholm. Dr. J. H. Soper made it possible for me to study the oak ferns in the herbarium at the University of Toronto.

PLATE 1328

Fig. 1. *Gymnocarpium dryopteris* var. *disjunctum*. Voucher specimen, $n = 40$, *Wagner 63087* and *Kruckeberg* (MICH).

PLATE 1329

Fig. 2. *Gymnocarpium heterosporum* n. sp. Type specimen. *Wagner 283* (MICH).

these plants are distinctive and most authors have upheld them as separate species. Good keys and brief descriptions are found in familiar manuals and guides (e.g., Tutin et al., 1964; Wherry, 1961); and the taxonomic characters are fairly well established.

At least two recent writers (Lawalrée, 1950; and Boivin, 1962) have questioned whether the two widespread taxa are specifically different. This question will be discussed further below. Also, there has been some disagreement about the generic placement of the oak ferns, but this matter will not be dealt with. Suffice it to say, the combination of characters does seem very well-marked, and in the past few years there has developed a widespread tendency to recognize *Gymnocarpium* as a distinct genus. The question is what its relationships are. The base number of $x = 40$ is quite different from such thelypteroid ferns as *Phegopteris* ($x = 30$), *Cyclosorus* ($x = 36$), and such species of *Thelypteris* as *T. palustris* ($x = 35$) and *T.*

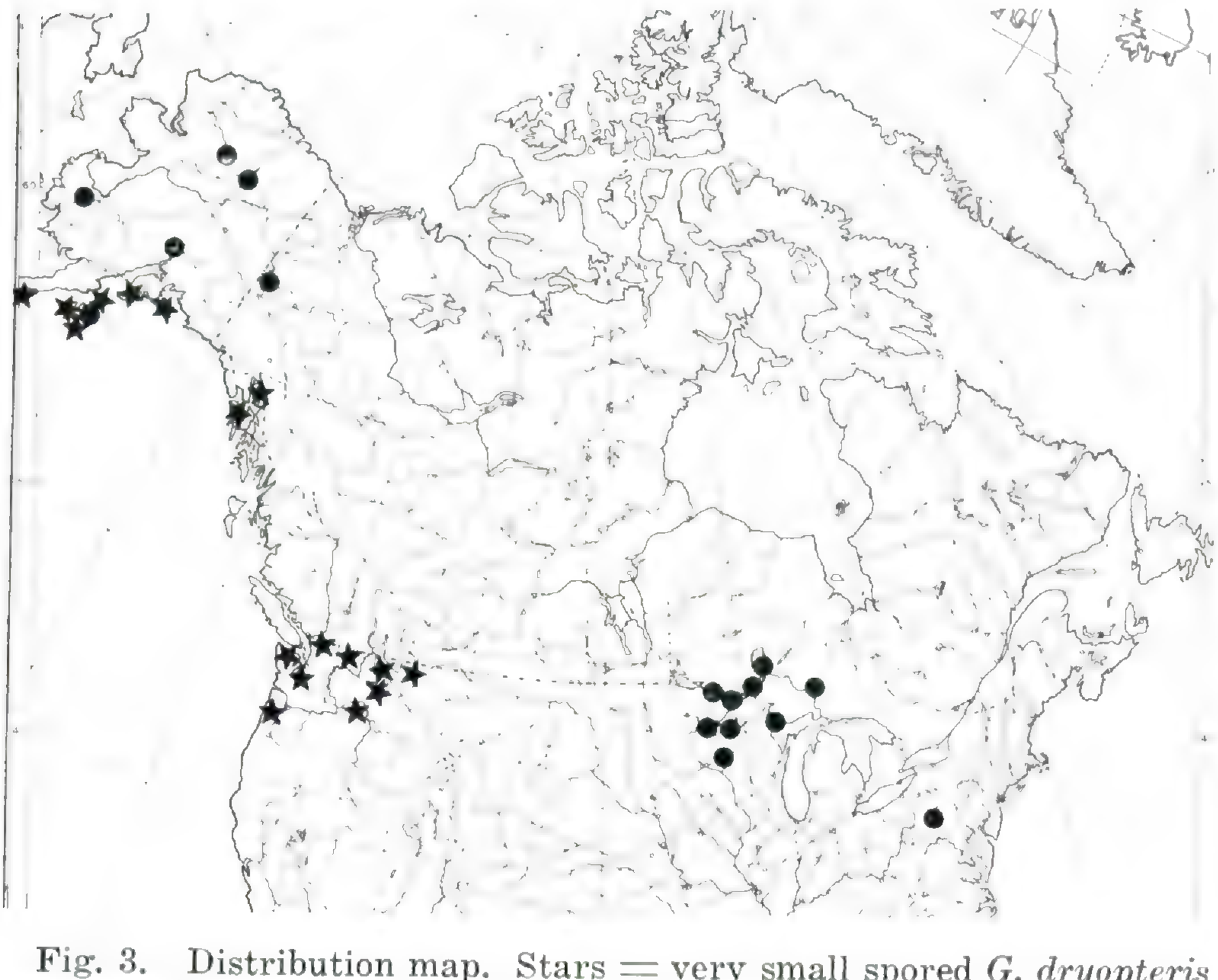

Fig. 3. Distribution map. Stars = very small spored *G. dryopteris* (less than 23.9 × 1.18 microns). Dots = *G. heterosporum*.

noveboracensis ($x = 27$). The chromosome number of *Gymnocarpium* resembles that of typical aspidioid ferns (e.g., *Dryopteris, Cystopteris, Polystichum, Tectaria, Ctenitis*, etc.) with $x = 40$, 41, or 42.

Elizabeth Root (1961) studied intermediates between *G. dryopteris* and *G. robertianum* and pointed out, for the first time, that "the majority of the spores of all intermediate specimens were found to be abortive." Since her study we have learned that the "hybrid" *Gymnocarpium* is much more frequent and widespread than had been heretofore realized, as is illustrated in the map (Fig. 3, dots). We have also discovered that there are three ploidal levels present in North American *Gymnocarpium* — the diploid, triploid, and tetraploid. These facts will be examined below in connection with the following questions: Are *G. dryopteris* and *G. robertianum* distinct species? Should the western representative of *G. dryopteris* be recognized as a separate variety or subspecies? What is the nature of the plants which are morphologically intermediate between *G. dryopteris* and *G. robertianum*?

THE DISTINCTNESS OF G. DRYOPTERIS AND G. ROBERTIANUM

Boivin (op. cit.) is the most recent worker who endeavored to interpret taxon *robertianum* as merely a variety of *G. dryopteris*. He did not find it possible to uphold taxon *robertianum* as a species because "Tous les caractères donnés chevauchent largement, sauf celui de la glandulosité qui est assez net si l'on excepte 6 ou 8 spécimens (sur environ 200 examiné). Cette glandulosité est si fine et ces deux espèces sont si semblables que, sur une cinquantaine de spécimens glanduleux examinés, un bon quart étaient mésidentifiés." I should point out that herbarium collections of ferns are often misidentified. The fact that certain species (e.g., in *Gymnocarpium, Dryopteris*, and *Botrychium*) are commonly misidentified should not be used as a basis for taxonomic judgments.

The reasons for upholding *G. robertianum* as a distinct species, rather than a variety of *G. dryopteris*, fall into two

classes: (1) The morphology of well-developed specimens is unquestionably distinct, including characters of the overall blade outline, the details of segment form, and the glandularity. Small, ecologically depauperated or juvenile, specimens may of course cause difficulties if only gross characters are used. But the glandularity of *G. robertianum* is evidently always a dependable character. (Some of the problems of detecting the extent of glandularity in these plants could be alleviated by eliminating the unfortunate herbarium practice of pasting down fronds, thus coating the delicate glands with a thin "varnish" which makes them practically invisible.) The only really intermediate plants in respect to glandularity are those to be discussed below, but these plants are intermediate in other respects also between *G. dryopteris* and *G. robertianum* and they are probably of hybrid origin. (2) The second reason for upholding *G. robertianum* is simply the behavior of the natural populations. The two species grow together in numerous localities in the Great Lakes area, in exactly the same habitats and growth conditions, and their distinctness is immediately evident to the field worker. The fact that these two taxa can exist together sympatrically without merging, and the fact that there is no genomic difference (both have n = 80 in this region) in ploidal level, shows that using the varietal rank to express their relationships would be stretching that category too far (cf. Wagner, 1960). The differences between these ferns are best seen in the rich, shady swamps of northern Michigan where they develop to the maximum size in the luxuriant, moist conditions. Mixed populations are well known in several localities near the University of Michigan Biological Station (Cheboygan, and nearby Presque Isle Cos., Michigan).

GYMNOCARPIUM DRYOPTERIS VAR. DISJUNCTUM

The western North American representatives of *G. dryopteris*, especially in Idaho, Oregon, Washington, U.S.A. and British Columbia, Canada, tend to develop unusually large fronds. The area is roughly that shown by the stars

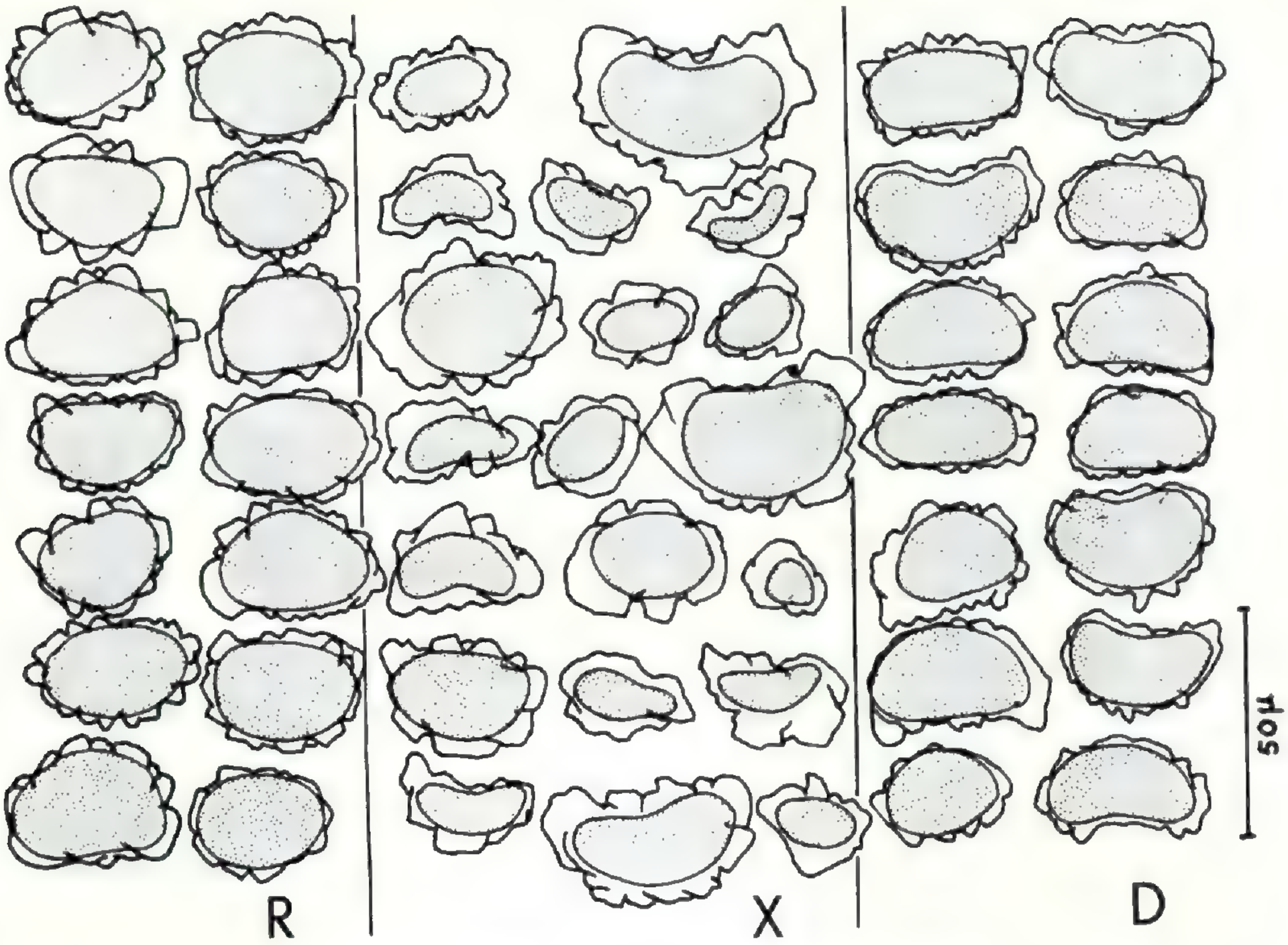

Fig. 4. Tracings of spores. Inner line = exospore; outer line = perispore. R. *Gymnocarpium robertianum*, Mich., *Voss 4709* (MICH). X. *G. heterosporum*, Pennsylvania, *Darling* in 1956 (MICH). D. *G. dryopteris*, Mich., *Voss 4708* (MICH).

of especially small-spored plants in Figure 3. In the most extreme form these plants become thrice-pinnate and the larger segments are more toothed than in typical *G. dryopteris*. Under the guidance of Dr. Arthur R. Kruckeberg of the University of Washington, I had an opportunity to study this form in the field. The best plants (Fig. 1) were seen in the deep coniferous woods at Denny Creek turnoff along U.S. 10, in the Snoqualmie National Forest, King Co., Washington. Here the "giant" *G. dryopteris* flourishes in damp, mossy forest with such other ferns as *Dryopteris dilatata* and *Athyrium filix-femina*, the latter two species also becoming remarkably large. Chromosome materials were obtained and squashes of meiosis showed clearly $n = 40$ pairs (Figs. 6 and 7, top illustrations). This is the first discovery of the diploid condition in the genus *Gymnocarpium*, all previous counts for which indicated the tetra-

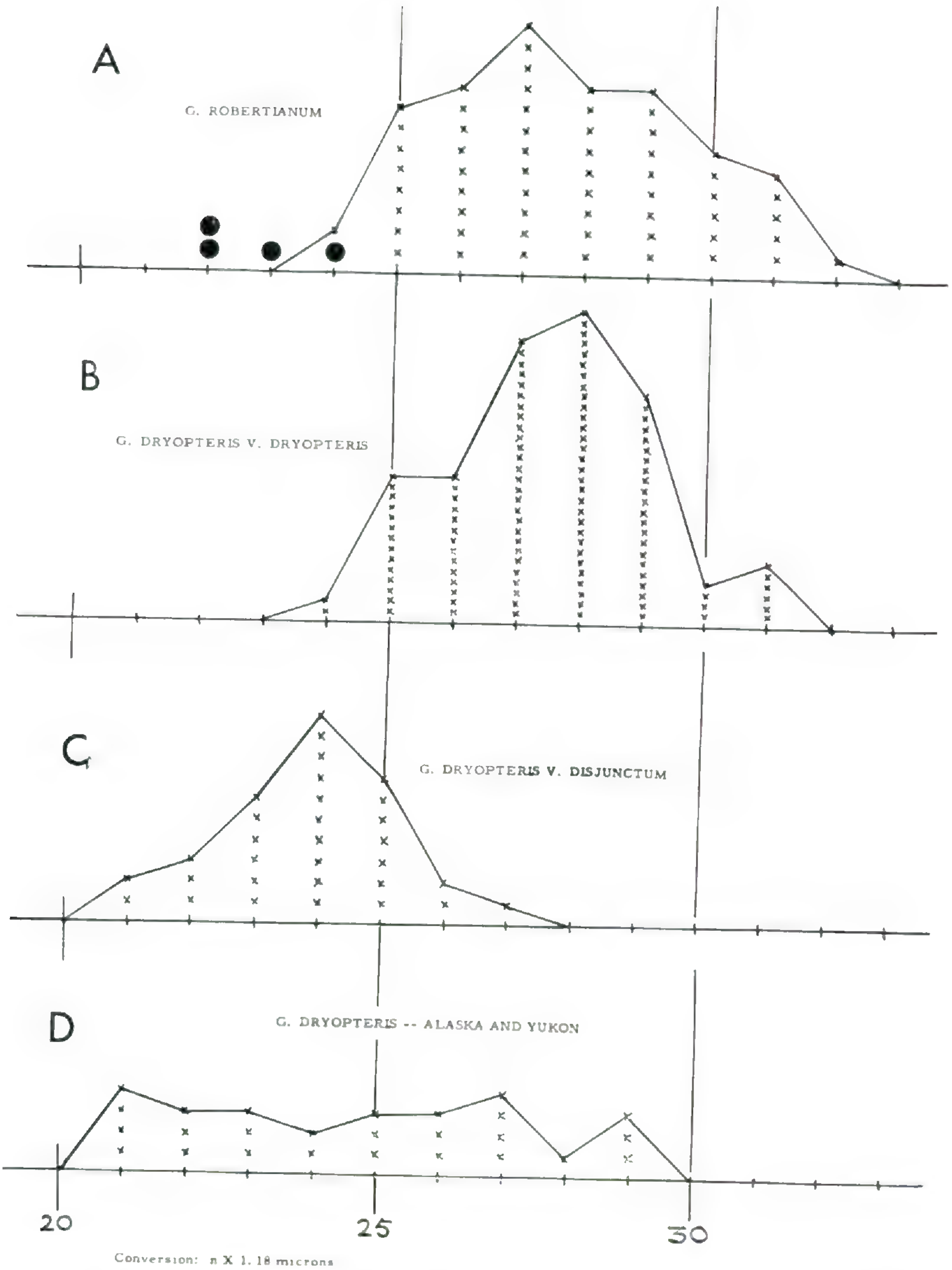

Fig. 5. Frequency histograms of spore lengths (exospore only). Each cross equals a 10-spore sample from a separate collection (Dots = spore samples of *G. continentale*). A. *G. robertianum*, all collections. B. *G. dryopteris*, all collections from Colorado east to Europe. C. *G. dryopteris*, all collections from British Columbia and Oregon east to Alberta and Montana. D. *G. dryopteris*, all collections from Alaska and Yukon. (Conversion: n × 1.18 microns).

ploid condition of $n = 80$. (According to spore size, as shown in Fig. 5, A, the chromosome number of the Siberian *G. continentale* may also turn out to be diploid.)

For several reasons — the diploid chromosome number, the smaller spores (Fig. 5), the larger, more divided leaf (Fig. 1) and the distinctive western range — I choose (with some reluctance, however) to uphold the plants with this combination of characters as a separate variety. Morton (1941, p. 217) pointed out that the name *disjunctum* was based upon specimens from Sitka, Alaska, "and refers to certain large, lax forms that are essentially tripinnate, with the lower tertiary pinnules somewhat spaced out." At the time of his writing, Morton was of the opinion that "they do not seem to be worth nomenclatural recognition . . . " Boivin (op. cit.), on the contrary, upheld the large form as a distinct variety.

Although I am inclined to agree now that var. *disjunctum* (Led.) Ching should probably merit recognition, I must point out that the situation becomes very complicated in Alaska and the Yukon, where both small- and large-spored types occur in the same general area (note the frequency histograms in Fig. 5, D). In this region also, we find numerous dwarfed individuals of both types, so that the gross appearance typical of "var. *disjunctum*" becomes modified and indistinguishable in many specimens from "var. *dryopteris*," using the respective spore sizes as the criterion. Thus many specimens from the far northwest of North America cannot be readily identified. Dwarfing obscures the gross characters of the fronds; and the overlap of spore sizes between the diploid and tetraploid conditions is such that many specimens could not be identified without chromosome counts.

Our spore surveys have uncovered still other complications, the full meaning of which must await further study. It turned out that a number of collections of what I had interpreted to be ordinary "var. *dryopteris*" have abortive spores which in appearance match those of the presumed hybrid fern to be discussed below (like those in Fig. 4, ×).

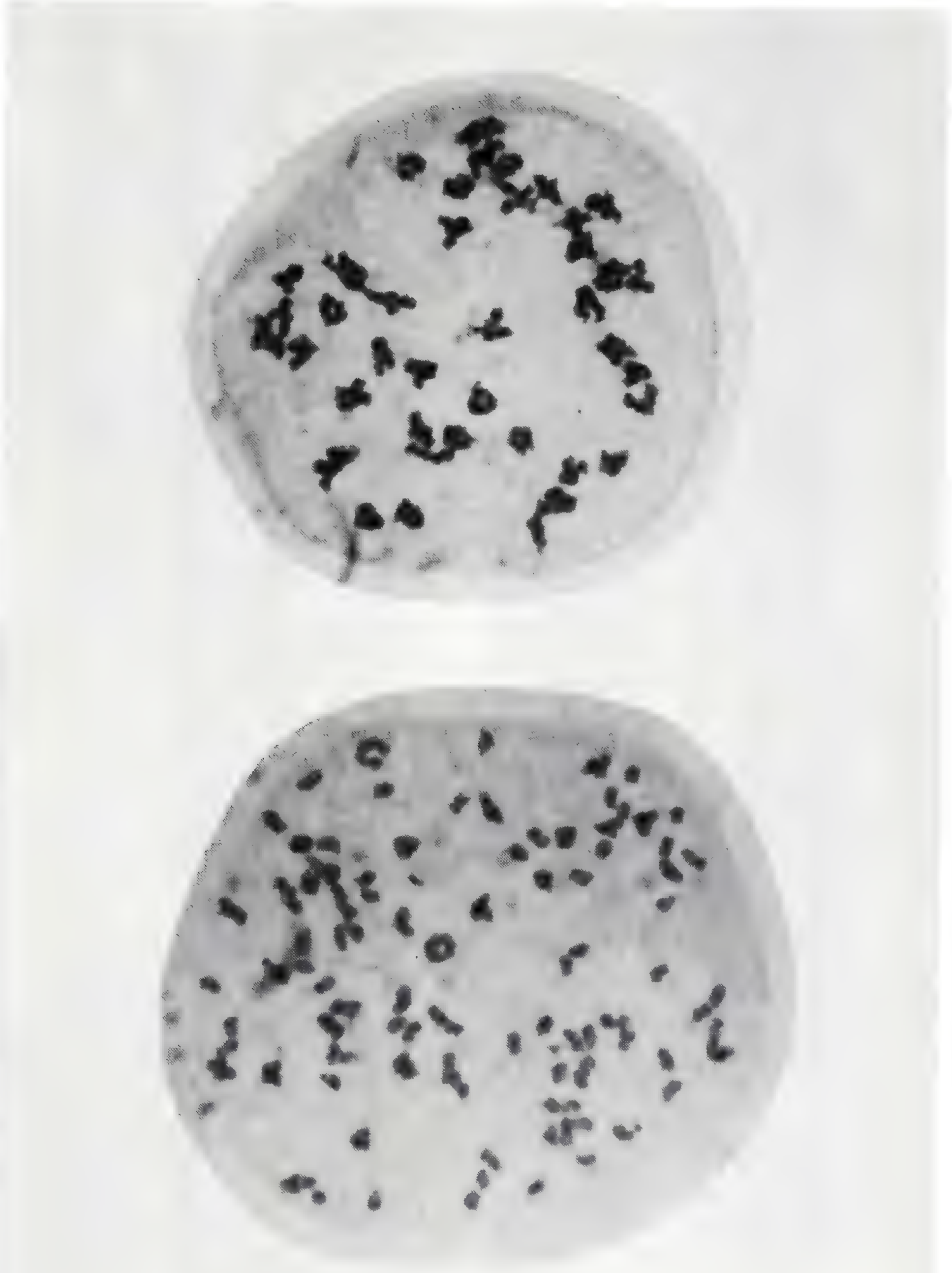

PLATE 1330

Fig. 6. New chromosome conditions in Gymnocarpium. Top: *G. dryopteris* var. *disjunctum* diploid, $n = 40$ pairs, *Wagner 63087* and *Kruckeberg* (interpretation top left in Fig. 7). Bottom: *G. heterosporum* triploid, $3\ x = $ c. 120, Wherry s.n., from Blair Co., Pennsylvania, in 1956 (bottom left in Fig. 7).

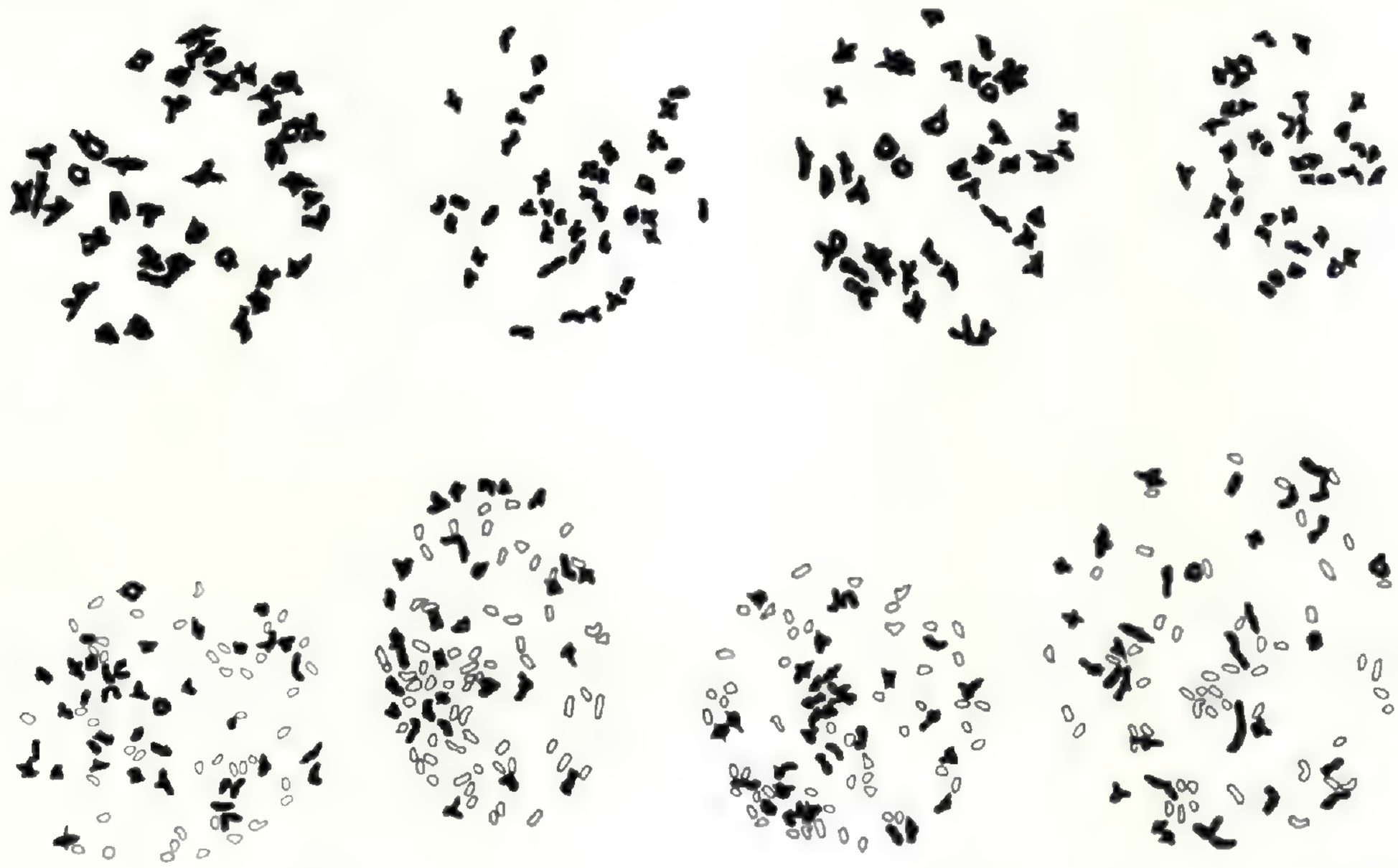

Fig. 7. Camera lucida interpretations of chromosome squashes. Top: Diploids, same locality as in Fig. 6. Bottom: Triploids, same locality as bottom photograph in Fig. 6.

Miss Virginia M. Morzenti kindly examined these collections and confirmed that the morphology of the abortion is very similar in the "sterile" *G. dryopteris* and the putative cross, *G. heterosporum*. It seems possible that at least some of these collections may be apomictic derivatives of *G. dryopteris* var. *disjunctum* (the diploid) × var. *dryopteris* (the tetraploid), assuming here, as elsewhere in this discussion, that the type of var. *disjunctum* corresponds to the diploid, large-leaved western plant. We failed to find a single example of *G. robertianum* in all those that we studied which showed a similar abortion of spores. Thus, if one argued that these "sterile" *G. dryopteris* plants might represent mutations that are propagated locally by rhizomes, we wonder why similar mutations were not found in the related *G. robertianum*. Those collections we found of presumably "sterile" *G. dryopteris* will not be enumerated in detail here, but their geographical distribution is extremely wide as shown by the following records: Alaska (2 collections), Alberta (1), British Columbia (1), Wisconsin (1), Michigan (5), New York (4), Vermont (2), Maine

(1), New Hampshire (1), Quebec (1), Newfoundland (2), and Nova Scotia (1). Further research on these curious "sterile" oak ferns with the morphology of *G. dryopteris* is greatly to be desired, especially to determine their cytological features and the mode of their reproduction.

THE APPARENT CROSS OF G. DRYOPTERIS AND G. ROBERTIANUM

This is the plant discussed by Root (op. cit.). As stated above, the apparent cross is much more frequent and widespread than we had previously realized. Its occurrence, especially in the western Great Lakes area, indicates that it is more than a rare hybrid, and I have concluded therefore that it should be given a binomial designation as an apomictic species, as follows:

Gymnocarpium heterosporum n. sp. W. H. Wagner. Planta frondis segmentique forma et glandularitate intermedia inter G. dryopteridem et G. robertianum; spori atro-brunnei, magnitudine et forma valde irregulares.

Type: PENNSYLVANIA: BLAIR CO., Canaan Station, limestone slope, *W. H. Wagner 283* (transferred from University of Pennsylvania to MICH — 2 sheets, one fertile, the holotype (Fig. 2), and one sterile).

Representative Collections: U.S.A.: PENNSYLVANIA: BLAIR CO., 2 mi. n. w. of Hollidaysburg, among limestone rocks, *T. Darling, Jr.* in 1956 — same locality as the type (MICH). MICHIGAN: MARQUETTE CO., ca. 6 mi. n. w. of Ishpeming, near Ropes Gold Mine, n. w. ¼ sect. 29, T 46 N, R 27 W, in woods on igneous rock cliffs, *E. G. Voss 4707, W. H. Wagner* and *D. J. Hagenah 9415* (MICH). WISCONSIN: BAYFIELD CO., Orienta Falls, *G. H. Conklin* and *M. F. Somerville 1127* (WIS); BARRON CO., Barron Hills, just n. w. of Lehigh at the base of quartzite talus, *N. C. Fasset 15817* (WIS), *R. M. Tryon, Jr. 4154* (WIS, GH, MO). MINNESOTA: CARLTON CO., Carlton, Carlton-Thompson Gorge, St. Louis R., *M. F. Somerville* in 1928 (MICH); ST. LOUIS CO., observation tower at Ash River, *Wagner 9034.5a* (MICH); LAKE CO., Gooseberry Falls State Park, 15 mi. n. e. of Two Harbors, in crevice of diabase cliff, damp and shady, *R. M.* and *A. F. Tryon, A. C. Faber 4889* (MO); 45 mi. n.e. of Two Harbors, Manitou Falls near Lake Superior, under ledge of diabase, damp and shady, *R. M.* and *A. F. Tryon, A. C. Faber 4895* (MO). CANADA: ONTARIO. ALGOMA DISTRICT, rocky cliffs at edge of Soulier Lake, vicinity of Michipicoten Harbor, *R. C. Rosie, H. M. Harrison, E. O. Hughes 1092* (TRT, GH). ONTARIO, THUNDER BAY DISTRICT, 1 mi. n. of Little Pigeon Bay, Crooks Twp., talus slope, mostly shale, common, *C. E. Garten 1933* (TRT); ca. 19 mi. n. of Nipigon, spruce-fir thickets on damp moss-covered talus

at foot of cliff, *E. G. Voss 10335* (MICH, TRT); 15 mi. e. of Port Arthur, 2 mi. w. of Silver Islet, shady sandstone talus, *R. M.* and *A. F. Tryon, A. C. Faber 4963* (MO). U.S.A.: ALASKA: WISEMAN, on Middle Fork of the Koyukuk River, ca. 67° 30′ N, 150° W, *Edith Scamman 913* (GH).[1]

This fern, being intermediate between the two familiar species of *Gymnocarpium*, and having obviously peculiar spores might more appropriately be designated as merely a sporadic hybrid (e.g., as *G. dryopteris* × *robertianum*). There are several reasons why this was not done. (1) The plants develop large colonies locally, and behave as an apomictic species. (2) As shown on the range map (Fig. 3) plants conforming to this description run from Alaska southeast through the western Great Lakes area (the region, evidently, of its greatest abundance) down to central Pennsylvania. (3) Cytogenetically (see below) at least one population, the type, is triploid, and not tetraploid as would be expected from our present knowledge of the parents as they occur in the eastern United States. The nearest diploids (judging from spore sizes and assuming correlation with the single diploid count) seem to be limited to the western part of the continent. (4) Finally, the intermediate is evidently to be found in at least some localities where one of the putative parents *(G. robertianum)* is unknown.

The holotype, but not the cotypes, of *Dryopteris linnaeana* C. Chr. f. *glandulosa* R. M. Tryon, Jr. (Amer. Fern Jour. **29:** 5, 1939) is evidently the same as the plant described above. The author wrote of his new "form" that the "rachis varies in glandularity, some specimens having only a few glands, while others have relatively many and rarely the blade is slightly glandular." Judging from the specimens cited, the author included two kinds of populations — the form of *G. dryopteris* in which the glands are more frequent and conspicuous than usual, and the plant described above. As to the glandular form of *G. dryopteris* itself, I am not sure that it is worthy of recognition. In her survey (1961, p. 18) Mrs. Root concluded that "It is generally stated that

---

[1]Additional collection localities not cited here but plotted in Fig. 3 were supplied by Dr. Eric Hultén.

the fronds and rachises of *G. dryopteris* range from glabrous to rarely slightly glandular. However, upon close examination of specimens from various localities it was found that *every* individual of this species examined has glands." In synonymizing "forma *glandulosa*" with *G. robertianum* (as "*G. dryopteris* var. *pumilum* (DC) Boivin"), Boivin (1962) was in error. Neither the type nor the cotypes of Tryon's form conform to the characters of *G. robertianum*.

Specimens of *G. heterosporum* in herbaria have previously been determined as one or the other of the putative parents, but most commonly as "*G. robertianum*" *or* "*G. dryopteris* f. *glandulosa*." The recognition of *G. heterosporum* is usually fairly easy in herbarium material, so long as the specimens have ripe spores. These tend to be discharged and to lie around the axes of the frond, sticking to the sheet. If the spores appear blackish and strongly irregular in size and shape, this is an excellent diagnostic feature, in combination with the presence of the intermediate condition of glandularity. The spores can be seen even with a dissecting microscope or a high power hand lens; and once their appearance is learned it becomes easy to pick out other collections with the same spore conditions, so a compound microscope is unnecessary. The spores of typical specimens of *G. robertianum* and *G. dryopteris* seem always to have a "glassy," tan or brownish color, and are strikingly regular. Both the soriferous specimens, as well as those which lack sori, of the intermediate oak fern will show the intermediate glandularity of the axes, especially on the upper parts of the rachis (if they have not been imbedded in herbarium paste). The glands of *G. heterosporum* are fewer and more widely spaced than they are in the densely glandular *G. robertianum*. In the field it is helpful to hold up the living fronds in the sun's rays and examine them with a good hand lens. The glands will glisten and thus be conspicuous, so that even small, sterile fronds of all three taxa, if growing together, may be separated.

Wherry (1942) described the habitat of the type population as follows (italics mine): " . . . the base of a steep

northwest-facing wooded slope, above a brook, the underlying rock being *limestone* which breaks into small angular blocks, from the crevices of which moisture oozes out, and by evaporation keeps the rocks cool." The Michigan station near Ishpeming, Marquette Co., is on steep shaded rock cliffs. In the latter area, the rocks contain serpentine. Garten took his specimens on a talus slope comprising mostly shale. The Lake Co., Minnesota, material was recorded from crevices of a "diabase cliff," while that from Barron Co., Wisconsin, came from "quartzite talus." The specimens from east of Port Arthur, Ontario, were found on "shady sandstone talus." Thus, ecologically, the substratum itself does not seem to matter much. The constant features of the habitats of *G. heterosporum* seem to be (a) shadiness, (b) moisture and humidity, (c) presence of rock substratum of some kind, the plants growing either directly from crevices of cliffs or upon the fallen talus. One or both of the presumed parental species may be present at the same locality.

CHROMOSOMES AND SPORES

The chromosomes and spores seem to have significance in this group of plants because of their variability and their correlation with each other and with other systematic data such as distribution and morphology of the fronds. There are three chromosome conditions. The tetraploid with $n =$ 80 or near that number is characteristic of *G. robertianum* as found by Manton and myself (Chiarugi, 1960; Fabbri, 1963). Judging from spore sizes (see Fig. 5) all populations of *G. robertianum* are probably tetraploid and the curve is normal. In Siberia, however, the rather similar *G. continentale* (Petrov) Pojark. has small spores (indicated by dots in the graph) and may be a diploid.

For *G. dryopteris* we first plotted all spore size averages and produced a broad, apparently undifferentiated curve. However, when we selected specimens from the area of presumably typical var. *disjunctum* (where we know there are diploids) an entirely different curve separated out. This area extends from British Columbia and Oregon east to

Alberta and Montana, and the spore sizes average between 23-25 × 1.18 microns[1] (Fig. 5, C) in maximum exospore diameter, in contrast to between 27-29 × 1.18 microns for var. *dryopteris* east of Colorado and including Europe (Fig. 5, B). Thus in *G. dryopteris* there is a correlation between spore size and polyploidy, as has been found in a number of other fern groups.

The "sterile-spored" *G. dryopteris* commented upon above may represent triploid populations, derived by interploidal hybridization and spreading by some means of spore disseminule not yet fully understood. The question is where the diploid and tetraploid may meet geographically. The graph of spore samples from Alaska (Fig. 5, D) shows values all the way from 21 to 29 micrometer units, strongly indicating that in this area, *G. dryopteris* is a mixture of ploidal levels.

It was extremely interesting to find that the type population of *G. heterosporum* (lower illustrations in Figs. 6 and 7) is triploid. Even though the pairing is very irregular, by totaling the estimated bivalents and univalents respectively of four sporocytes the following numbers resulted: (29) + 63, (33) + 50, (33) + 55, and (39) + 42. Their average was (33.5) + 52.5, or 119.5 chromosomes in all. Assuming that *G. heterosporum* is truly of hybrid origin and that both *G. dryopteris* and *G. robertianum* in the eastern U. S. are tetraploid, then it is possible that the type population originated as 2x *G. dryopteris* var. *disjunctum* × 4x *G. robertianum*. Further cytological surveys of *G. heterosporum* in other areas are highly desirable. It is possible that 4x forms of it exist.

I must alert collectors to the need of obtaining fertile materials of these plants of which the sori contain ripe spores. Out of 500 specimens that we examined, 150 proved to be sterile or too young for spore observations. Also, I should point out that it is not correct that the spores of

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[1]Conversion factor: one micrometer unit = 1.18 microns. Fig. 5 is plotted in micrometer units only, from spores taken from herbarium specimens and mounted directly in diaphane.

Gymnocarpium lack perispores. Ching's description of "spores bilateral, warty, and without perispore" (quoted in Morton, 1941) surely does not conform to our observations. As shown in the spore tracings in Figure 4, there are two clearly defined layers — the outer, perisporial covering which is irregular, and the inner, exosporial boundary which is smooth. This is not different from other members of this group of ferns associated with *Thelypteris* and *Dryopteris*. The perispores of *Gymnocarpium* show up especially well in the abortive spores of "sterile *G. dryopteris*" and of *G. heterosporum*, where they actually are more or less exaggerated in development. This excessive perisporial thickness is probably the factor which produces the darker, nearly black, appearance of the spores as seen en masse.

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LACTUCA MURALIS IN NEW ENGLAND

Recently a number of duplicates from a collection of New Hampshire plants by Andrew P. Nelson, Assistant Professor of Biology at Dartmouth College, were sent to Professor Albion R. Hodgdon at the University of New Hampshire. Among these was a specimen of *Lactuca muralis* (L.) Gaertn. (*A. P. Nelson 1059*) that was collected by the side of a gravel road between Cornish Mills and Plainfield in the town of Cornish, Sullivan County, N. H. on August 6, 1964. Professor Hodgdon states that this is the first report for this species in New England. Gray's Manual, 8th edition, describes the species as growing on roadsides and in waste places, local, w. Que., and e. N. Y. to Mich. (Adv. from Eu.). In Gleason and Cronquist *Manual of Vascular Plants* (1963) it is listed as a native of n. Eu. now known from N. Y. and Que. Voucher specimens have been deposited in the herbarium of the New England Botanical Club, Cambridge, Mass. and in the Pringle Herbarium at the University of Vermont in addition to the specimens in the University of New Hampshire Herbarium and the Jesup Herbarium.

JAMES P. POOLE, CURATOR.
JESUP HERBARIUM, DARTMOUTH COLLEGE

CUCHUMATANEA
A NEW GENUS OF THE COMPOSITAE (HELIANTHEAE)[1]

C. E. SEIDENSCHNUR AND J. H. BEAMAN

Cuchumatanea Seidenschnur & Beaman, gen. nov.

Herba annua, minuta, depressa. Folia opposita, spathulata, obscure trinervia, basi leviter connata. Rami oppositi ad nodos. Capitula homogama, sessilia vel subsessilia, terminalia, solitaria, cum pare foliorum clavato-spathulatorum circumclusa. Phyllaria 2, late oblongo-obovata, basi subite attenuata, membranacea valde concava, laxe flosculos involventia. Receptaculum conicum, paleaceum, paleis membranaceis flosculos non amplectentibus, exterioribus oblongo-ovatis, interioribus gradatim angustioribus usque ad centrales lineares. Flosculi 5-10 in capitulo, hermaphroditi actinomorphi. Corolla anguste tubuloso-campanulata, 3-4 lobata, infra flava, sursum purpurea. Stamina 3-4, antheris connatis basi sagittatis, apice cum appendice late ovata vel suborbiculata ornata. Stylus infra ramos contractus, ramis oblongo-ellipticis, acutis, lato margine dorsoque dense papilloso. Achaenia ellipsoideo-oblonga deorsum paulo attenuata levissime compressa, striolata, brunneo-nigra. Pappus nullus.

Minute, depressed annual. Leaves opposite, spatulate, inconspicuously 3-veined, the bases slightly connate. Each node with two axillary branches. Heads homogamous, sessile or subsessile, solitary, terminal, surrounded by a pair of spatulate-clavate leaves. Phyllaries 2, broadly oblong-obovate, subpetiolate, membranaceous, strongly concave, loosely enclosing the florets, the outer oblong-ovate, the inner becoming progressively narrower, the innermost linear. Florets 5-10, hermaphroditic, actinomorphic. Corolla tubular, narrowly campanulate, 3-4 lobed, yellowish below, purplish above. Stamens 3-4, anthers connate, sagittate, with broadly ovate to suborbicular apical appendages. Style constricted just below the branches, the branches oblong-elliptical, acute, papillose to the base. Achenes ellipsoid-oblong, weakly compressed, brownish-black, striate. Pappus absent.

Cuchumatanea steyermarkii Seidenschnur & Beaman, sp. nov.

Herba annua, minuta, depressa usque ad 1 cm. alta, radice palari, saepe caespitosa. Caulis plus minusve sparse hirtellus vel glabratus,

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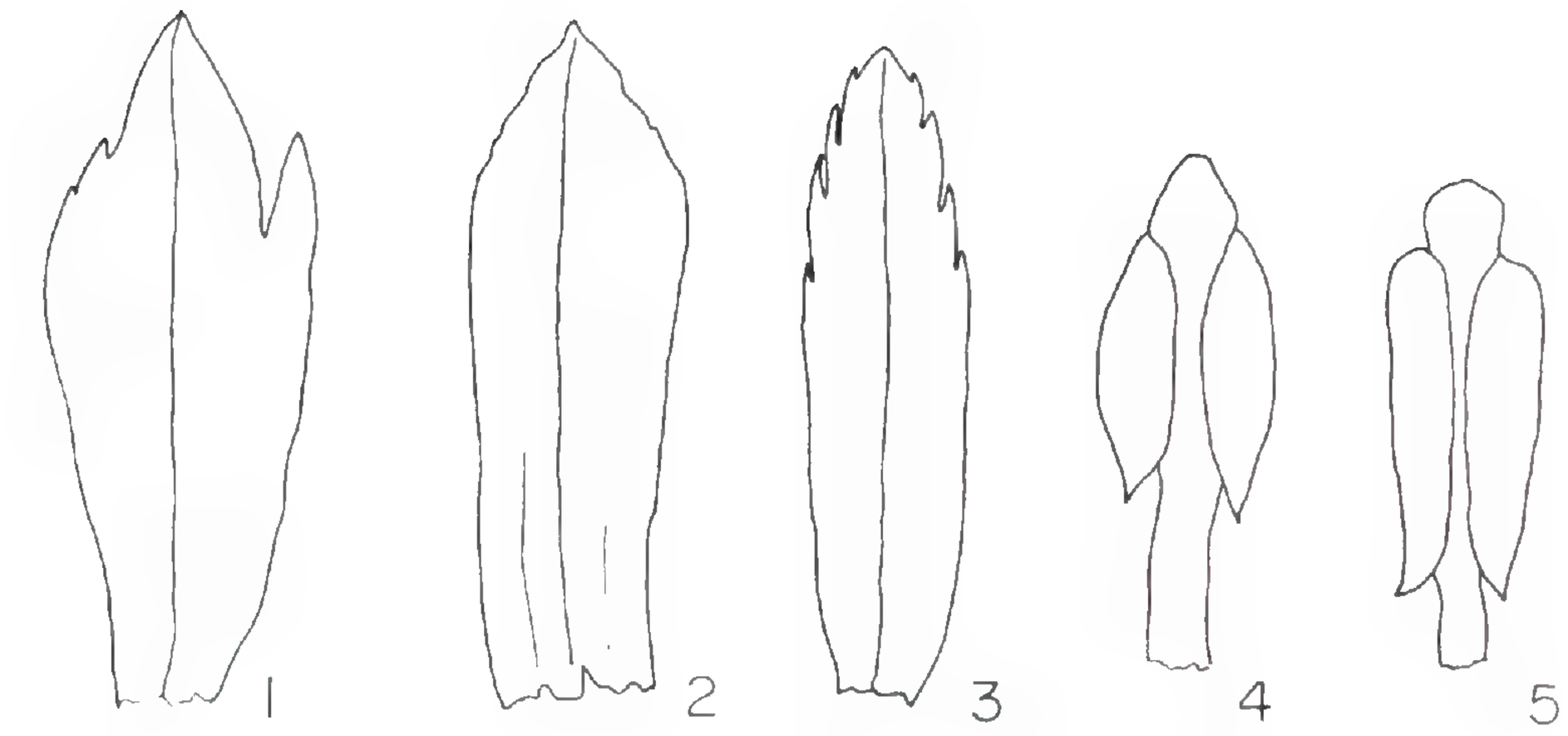
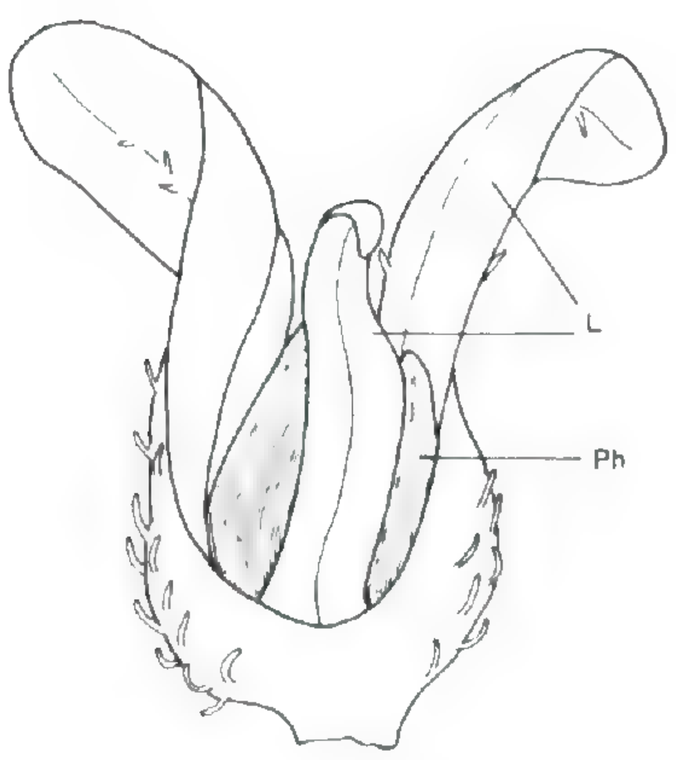
[1]The genus was discovered in the course of field work supported by National Science Foundation Grant G-9045. The research has been conducted in connection with NSF Grant GE-4051 for Undergraduate Research Participation. We are indebted to Dr. José Cuatrecasas for helpful suggestions and for preparing the Latin diagnoses and to Dr. D. C. D. De Jong for making the cytological preparations.





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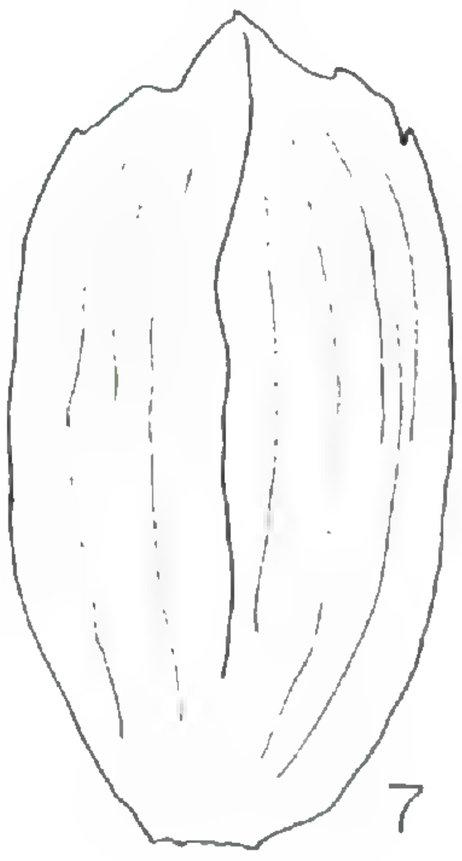

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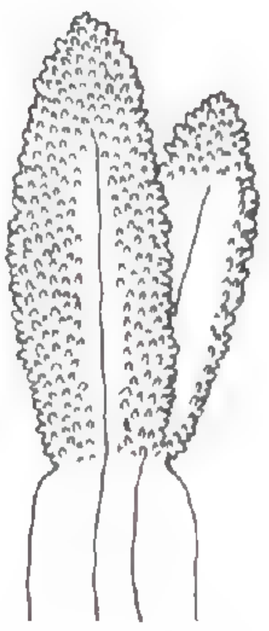

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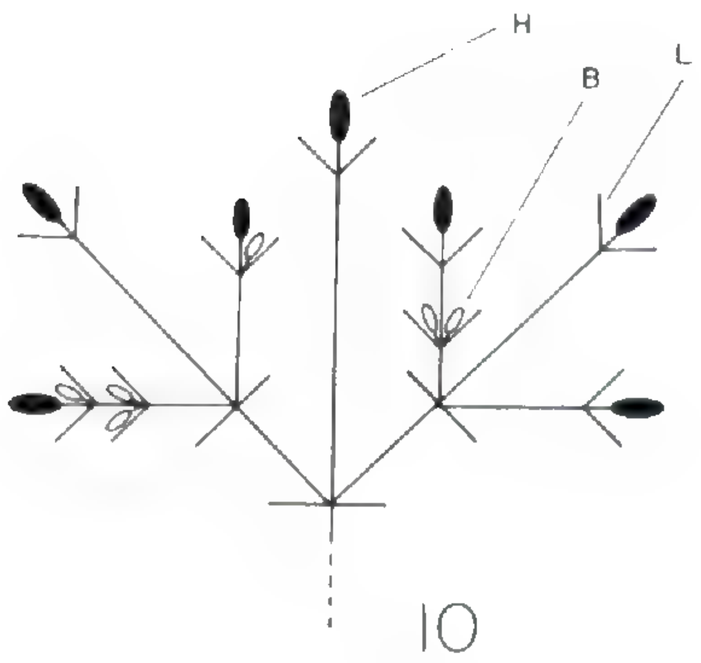

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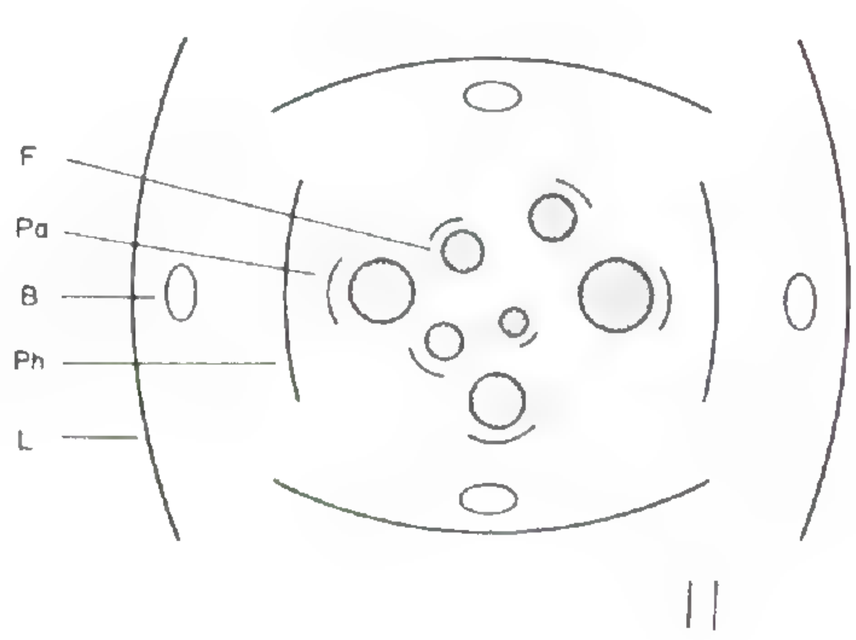

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[Legend for figures 1-11]

Fig. 1-4, 6-11. *Cuchumatanea steyermarkii*, based on *Beaman 3962*. Fig. 5. *Jaegeria hirta*, based on *Beaman 4532*. Fig. 1-3. Pales (× 15). Fig. 4-5. Stamens (× 40). Fig. 6. Head and subtending leaves (× 7, L, leaf; Ph, phyllary). Fig. 7. Phyllary (× 15). Fig. 8. Floret with achene (× 20). Fig. 9. Style branches (× 75). Fig. 10. Diagram of a terminal portion of the branching system (B, bud; H, head; L, leaf). Fig. 11. Diagram of a head with subtending leaves (B, bud; F, floret; L, leaf; Pa, pale; Ph, phyllary).

viridis vel purpurascens composite dichasiale ramosus. Folia opposita decussata, basi paulo connata, saepe in pare inaequilonga, 3-7 mm longa 0.8-3 mm lata, spathulata, integra, margine parce revoluta sparseque ciliata, 3-nervata sed nervis plerumque inconspicuis, supra glabra, subtus praecipue in nervo medio sparse pubescens. Capitula homogama, sessilia vel subsessilia, terminalia, solitaria, campanulata, circa 2 mm alta 1 mm lata, cum duobus foliis brevibus clavato-spathulatis amplectentibus, 2-3 mm longis 1.2 mm latis, adpresse subtendentia partimque tecta. Phyllaria 2 circa 2.5 mm longa 1.5 mm lata plerumque inaequilonga, oblongo-ovata basim angustata, membranacea sed apice recurva herbacea leviter lacerata, 3-venulosa, dorso ad venulam mediam parcis pilis, valde concava, laxe flosculos involventia. Receptaculum 0.2-0.5 mm altum, conicum, paleaceum. Paleae membranaceae persistentes flosculos non involventes, 1.5-2 mm longae, venula media conspicua aliquando 2-3 venulis lateralibus fere inconspicuis, glabrae, sursum margine minute laceratae deorsum integrae, exteriores oblongo-ovatae, ceterae gradatim angustiores usque ad centrum lineares. Flores omnes hermaphroditi, 5-10, plerumque 7 in capitulo. Corolla tubulosa 1 mm longa, limbo subcampanulato, 3-4 lobato, lobis ovatis acutis purpureis glabrisque, tubulo 0.5 mm longo flavo, sparse pilosulo. Stamina 3-4 non semper pari quam corollae lobi, antheris basi sagittatis, apice appendice ovata vel suborbiculata, thecis 0.4 mm longis parietibus crassis. Stylus infra lobos constrictus, ramis oblongo-ellipticis, acutis, marginibus dorsoque papilloso, uno saepe quam altero longiore. Achaenia 1.1 mm longa, ellipsoideo-oblonga, basim versus attenuata, levissime compressa, basi obtusa, brunneo-nigra, striata, glabra. Pappus nullus. Chromosoma $n = 8$.

Minute, depressed, taprooted annual herb, 1 cm or less high, occurring in patches and tending to form open mats. Stems glabrate to sparsely hirtellous, greenish or purplish, with two axillary branches at each node, one branch system arising from each leaf axil. Leaves opposite, decussate, 3-7 mm long, 0.8-3 mm wide, one member of each pair usually larger than the other, spatulate, entire, the bases slightly connate, margins sparsely ciliate, somewhat revolute, with 3 inconspicuous veins, glabrous adaxially, sparsely pubescent mostly on the midvein below. Heads homogamous, sessile or subsessile, solitary, terminal, campanulate, ca. 2 mm high and 1 mm wide, closely subtended and partly covered by a pair of small spatulate-clavate leaves 2-3 mm long and 1.2 mm wide. Phyllaries 2, ca. 2.5 mm long, 1.5 mm wide, one usually larger than the other, oblong-obovate, narrowing basally, mostly membranaceous but with herbaceous reflexed tip, lacerate near the apex, 3-veined, with a few hairs abaxially on the median vein, strongly concave, loosely enclosing the florets. Receptacle 0.2-0.5 mm high, conical, paleaceous. Pales membranaceous, not surrounding the florets, 1.5-2 mm long, 1-veined, sometimes 2-3 incon-

spicuous lateral veins present, glabrous, minutely lacerate above, entire below, the outer oblong-ovate, the inner becoming progressively narrower, linear at the center of the head, persistent. Ray florets absent. Disk florets 5-10, commonly 7, hermaphroditic. Corollas tubular, narrowly campanulate, ca. 1 mm long, with 3-4 ovate acute lobes, tube 0.5 mm long, yellow, sparsely pilose, limb and lobes purplish, glabrous. Stamens 3-4, usually of the same number as the corolla lobes, anthers connate, sagittate, with broadly ovate to suborbicular apical appendages, thecae 0.4 mm long, with thick walls. Style constricted just below the branches, style branches oblong-elliptical, acute, papillose to the base, one branch often longer than the other. Achenes 1.1 mm long, ellipsoid-oblong, weakly compressed, with an obtuse base, brownish-black, striate, glabrous. Pappus absent. Chromosome number $n = 8$, based on *Beaman 3962*. Fig. 1-11.

GUATEMALA. HUEHUETENANGO: Sierra de los Cuchumatanes, ca. 3 kms south of road between Llano de San Miguel and Todos Santos, from a point 2.5 miles west of Llano de San Miguel, near the highest point in the Cuchumatanes, collected from about the 3,680 to 3,740 meter level, in open *Pinus rudis* forest, occurring in patches in black soil near limestone outcrops, frequent in a local area, 2 August 1960, *J. H. Beaman 3962* (MSC *171943*, holotype; F, GH, K, TEX, UC, US isotypes); vicinity of Chémal, summit of Sierra de los Cuchumatanes, 3,700-3,750 m, *Steyermark 50260* (F).

The existence of this remarkable tiny plant was first pointed out by Dr. Julian A. Steyermark to Beaman in connection with the planning of a collecting expedition to Guatemala in 1959. Dr. Steyermark found it on August 8, 1942, in the vicinity of Chémal, Sierra de los Cuchumatanes, Department of Huehuetenango, Guatemala. In his field book he noted that it was annual, with the corolla yellow, the leaves green and shining, fleshy, fairly membranaceous, growing in bunches and patches. His collection was subsequently examined by Dr. S. F. Blake who suggested to Steyermark that it probably represented a new genus near *Jaegeria* or *Schkuhria*. Blake pencilled on the sheet: "Jaegeria? Material too scanty & depauperate." In early August, 1959, and late July, 1960, Beaman made unsuccessful searches for the species in the vicinity of Chémal. But on August 2, 1960, it was discovered a few kilometers southwest of Chémal in one of the highest and most remote regions of the Cuchumatanes. In publishing the species it is a pleasure to associate the name of Dr. Steyermark with

that of the Sierra de los Cuchumatanes. He has been the leading contributor to the understanding of the exceptionally diverse and unusual flora of this mountain range.

Cuchumatanea steyermarkii is an extremely reduced species, especially characterized by reduction of the plant body and of the florets. There is also slight asymmetry of the pairs of axillary branches, leaf and phyllary pairs, and style branches, with one member of each pair generally somewhat smaller than the other. In spite of reduction in size, however, the species has retained a complex branching system (see fig. 10). Two branches generally arise from each of the 3-4 nodes (except the first which is often unbranched). Additional axillary branches or buds are also present at the nodes of the primary branches. A solitary head terminates each branch.

The heads are enclosed and somewhat concealed by subtending pairs of leaves. The two phyllaries follow the decussate pattern of the leaves (see fig. 6 and 11) and resemble immature leaves. In immature heads the subtending leaves are differentiated from the phyllaries mainly by the ciliate margins of the former and by their position. The two phyllaries partially surround the head and each subtends a pale and a marginal floret which is more advanced in development than other florets of the head.

The number of corolla lobes varies from 3 to 4, which is also true for the stamens. While the number of corolla lobes and stamens is often the same, there are sometimes florets with 4-lobed corollas and 3 stamens. Florets with 3-lobed corollas and 4 stamens have not been found. In one floret with two normal stamens a third stamen was found with the filament of twice the normal width and two fused anthers. Such a condition may support the contention that the 3- and 4-merous florets are the result of a reduction process which is still in progress.

Our findings confirm Blake's suggestion that the genus is related to *Jaegeria*. Among species of this genus it appears to be closest to *J. hirta* (Lag.) Less. The habit of *Cuchumatanea* is very similar to that of a collection of *J.*

Table 1. Comparison of *Cuchumatanea* with related genera.

	Cuchumatanea (*C. steyermarkii*, *Beaman 3962*)	*Jaegeria* (*J. hirta*, *Beaman 4532*)	*Siegesbeckia* (*S. repens*, *Beaman 3699*)	*Selloa* (*S. plantaginea*, *Beaman 4240*)
Heads	Discoid	Radiate	Radiate	Radiate
Phyllaries	2	5	5 outer and 2 series of inner	Very broad, imbricated in about 4 series
Pales	Not keeled	Keeled	Not keeled	Not keeled, narrowly linear
Number of disk florets	5-10	5-9	Ca. 40	Ca. 85
Number of disk corolla lobes	3-4	4-5	5	5
Style	Constricted below the branches	Not constricted	Not constricted	Not constricted
Style branches	Oblong-elliptical, acute, often unequal, papillose to the base	Lanceolate, acute, papillose to the base	Linear, acute, papillose to the base	Linear with triangular, tufted tips
Stamens	3-4, anthers sagittate, with broadly ovate to suborbicular appendages	5, anthers sagittate, with orbicular appendages	5, anthers slightly sagittate, green, with ovate appendages	5, anthers slightly sagittate, with broadly ovate appendages
Achenes	Brownish-black, striate, ellipsoid-oblong, glabrous	Brownish-black, striate, ellipsoid-oblong, glabrous	Brownish-black, striate, ellipsoid-oblong, glabrous	Brownish, striate, 5-angled, ellipsoid-oblong, glabrous
Pappus	Absent	Absent	Absent	3-5 deciduous awns

hirta (Beaman 4532) from La Cima, Federal District, Mexico. This specimen also has sagittate anthers with orbicular appendages which correspond closely to those of *Cuchumatanea*, although the latter has shorter thecae with thicker-walled cells along the margins. In another specimen of *J. hirta* (*Bourgeau 1553* from the Valley of Cordoba, Mexico) the anthers seem to differ from those of *Cuchumatanea* mainly in not having thick-walled marginal cells. The genera are also similar in achenial structure, both having ellipsoid-oblong, slightly compressed, striate, glabrous achenes without pappus[2]

Although the features noted above indicate a close relationship of *Cuchumatanea* with *Jaegeria*, they differ by characters of a magnitude equal to those by which other Verbesinoid and Galinsoginoid Compositae are distinguished. The most important characters which separate the genera are as follows: (1) The heads of *Cuchumatanea* are discoid. Only *J. gracilis* Hook. f. from the Galapagos Islands is without ray florets (the type of *J. discoidea* Klatt, as noted by Robinson (1900), is radiate). (2) *Cuchumatanea* has only two phyllaries which do not surround the marginal florets but partially enclose the head. *Jaegeria* has 5 or more phyllaries each of which encloses an ovary or achene of a ray floret with slightly overlapping marginal membranes. (3) The tubular corollas of *Cuchumatanea* have 3-4 lobes rather than 5 as in *Jaegeria*, and the number of stamens in the former is also reduced. (4) The pales are unkeeled in *Cuchumatanea* and keeled in *Jaegeria*. (5) The chromosome number in *Cuchumatanea* is $n = 8$, while counts reported for four species of *Jaegeria* have all been on the base of $x = 9$ (Turner et al., 1962; Beaman and Turner, 1962; Turner

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[2]After submitting the manuscript for publication we sent a copy of it and some of the material of *Cuchumatanea* to Dr. A. M. Torres who is currently monographing the genus *Jaegeria*. He notes that the specimen of *Jaegeria hirta (Beaman 4532)* which we have used for comparison is at the extreme end of variation (a reduced form) in this species and that more typical specimens appear less similar to *Cuchumatanea*. He considers *J. axillaris* Blake, known only from the type collection from Colombia, to be closer to *Cuchumatanea*.

and King, 1964). A further comparison of similarities and differences of *Cuchumatanea* and *Jaegeria*, in addition to the characters of two other related genera, is given in Table 1. We have not found any features to support Blake's tentative suggestion that *Cuchumatanea* might be related to *Schkuhria* (Helenieae).

Because of its alliance with *Jaegeria* and other genera placed by Hoffmann (1894) in the subtribe Verbesininae, we tentatively assign *Cuchumatanea* to this subtribe next to *Jaegeria*. A more satisfactory classification may ultimately bring certain genera of the Galinsoginae into closer association with this group of the Verbesininae.

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SEED GERMINATION OF SHORTIA GALACIFOLIA T. & G. UNDER CONTROLLED CONDITIONS[1]

MARY H. RHOADES[2]

Until 1936 it was belived that *Shortia galacifolia* could not reproduce by seed because the scapes decayed and fell over before the seeds were mature (Kelsey, 1902). Observations by Ross (1936) disclosed that Shortia seeds do reach maturity and germinate, but in an unusual manner. Germination occurs in the capsule, the seeds being held against the placenta by the firm, partially opened capsule walls. In this position the seeds do not readily fall out when ripe, and are kept fairly moist because the capsule and cup-like calyx retain water. Seedlings reach the ground when the scape decays and falls. There they have little chance of survival because of predation by insects and because of the dense mass which Shortia plants form by vegetative reproduction. Attempts by Ross to germinate seeds on soil in the laboratory were unsuccessful, and he concluded that there was little possibility for the spread of Shortia plants by seed.

Ross's work suggests that seedlings of Shortia would be rare in nature, and that most of them would be near mature Shortia plants. On the contrary, several people have reported finding abundant seedlings in the field, both underneath (Crandall, 1956) and several feet from patches of mature plants (Crandall, 1956; Vivian, 1965). However, it was not determined whether these seedlings were from seeds which germinated in the capsule or on the ground. Since it is more likely that seeds are transported rather than seedlings, it appeared worthwhile to investigate the possibility of seed germination outside the capsule.

Capsules of *Shortia galacifolia* were collected on May 15, 1964, at an elevation of 1440 feet on the northwest side of

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Crossroads Mountain in Transylvania County, N.C. The capsules were open and most of them contained many seeds, but no seedlings were found in them. Immediately when picked they were wrapped in paper towels and put in plastic bags to prevent drying.

A previous experiment showed that freezing the seeds did not impair germination, so the capsules were kept frozen until the seeds could be removed and counted. When the seeds were removed from the capsules, those with any visible defect, such as mold, discoloration, or extreme flatness, were discarded. The sound seeds were then put into envelopes of 50 seeds each and refrozen until all seeds were sorted. To prevent the seeds from drying out, only about six capsules were taken from the refrigerator at a time for removal of the seeds.

Eight environmental factors were tested for their effects on germination. Temperature, moisture, and light were combined into one experiment, so there were six experiments in all. For all but the first experiment, germination was tested in an air-conditioned room with a temperature range of 20° to 24°C and a light intensity of 30 ft-c. Germination was tested in all treatments, except those involving soil, by sprinkling the seeds on moist Whatman No. 1 filter paper in a clean 9 cm petri dish. The paper was moistened once a day with distilled water from a medicine dropper.

Each treatment included six replications of 50 seeds each. The seeds were assigned to a particular treatment by numbering the envelopes of seeds and then using a table of random numbers to select the envelopes for a prearranged order of treatments. The number of seeds germinated was recorded every 4 days up to 32 days, and then once again after 50 days. The first appearance of the radical was the criterion for germination.

To determine the effect of the interaction of temperature, moisture and light, germination was tested at 10°, 20°, and 30°C, in the light and the dark, and at three moisture levels. The moisture levels were "abundant," in which the filter paper was saturated with water; "sufficient," in which it

was thoroughly moistened but not saturated; and "deficient," in which it was never thoroughly moistened. Both incandescent and fluorescent lamps provided illumination. The combinations of three temperatures, two light conditions, and three moisture levels made 18 treatments.

Two other treatments tested the effect of a changing temperature regime on germination. In one treatment seeds were placed alternately between 10°C and 20°C every 48 hours. In the other treatment seeds were moved progressively from 10°C, to 20°C, to 30°C. After 5 days at each of these temperatures, the seeds were put at 22°C for the remaining time. For both of the changing temperature treatments the seeds were kept in the light and given "sufficient" moisture.

Since Shortia seeds germinate within the capsule, it was decided to test the effect of capsule parts on germination. For example, the calyx from about 10 capsules was cut up and the pieces were sprinkled on the filter paper along with the seeds. The placenta, calyx, and ovary wall were tested for their effects in this way. To obviate the effect of moisture retention by capsule parts, a control treatment was set up in which pieces of filter paper were sprinkled in the dishes. The cumulative effect of the capsule parts was tested by two treatments: putting seeds into empty, intact capsules and putting pieces of all capsule parts with the seeds.

Three other experiments were designed to test the effect on germination of substrate type, acid, and soaking. Steam sterilized sand, sphagnum, and a mixture of two parts sandy loam, one part sand, and one part sphagnum were the substrates tested. Petri dishes were half filled with the substrate and the seeds were sown on the surface, which was kept moist. The acid solutions tried were glacial acetic acid of pH 3.5 and two leachates of pH 4.5, one of moss and the other of leaf litter collected at the site where the seeds were obtained. Soaking periods used were 1, 3, 6, and 9 days in distilled water. Seeds kept at 22°C in the light and with "sufficient" moisture were used as the control for all tests.

In the final experiment six lots of 200 seeds each were put in petri dishes and allowed to air dry for 1 to 6 days before they were transferred to moist filter paper. Duplicate sets of 100 seeds each were also air dried, then weighed and oven dried at 105°C to a constant weight. In this way moisture content of the seeds, as percentage oven-dry weight, was determined for each of the air drying periods.

Although eight tests were designed for statistical treatment of the results, for some tests the great variation in number of seeds germinated among replications or the low total number of seeds germinated made a meaningful statistical analysis impossible. Even the mean and the standard deviation cannot be given for some treatments because they indicate the possibility of a negative number of germinations, which is meaningless.

Table 1 gives the results for the effect of temperature, moisture, and light on germination. Many more seeds germinated at 20°C than at 30° or 10°C, and more germinated in the light than in the dark. No germination occurred at the "deficient" moisture level in any temperature regime. At 20°C more seeds germinated in the "abundant" moisture condition than in the "sufficient." The difference is significant at the 2.5% level using a Student's t-test (Abundant, mean number of germinations/50 seeds = 4.33 ± 1.51; Sufficient, mean = 2.17 ± 1.33).

The effect of the changing temperature treatments on germination is also shown in Table 1. Almost identical results were obtained for the two treatments. A constant temperature of 20°C was as good for germination and perhaps better than, the two changing temperature regimes.

The presence of the placenta, the calyx, the ovary wall, or all parts improved germination about fivefold over that of the control. An analysis of variance using the 2.5% significance level showed that there was no difference among the treatments involving capsule parts. Adding filter paper instead of capsule parts did not improve germination.

Sand and sphagnum were superior to the sandy loam mixture or filter paper as substrates for seed germination.

Table 1. Effect of Temperature, Moisture, and Light On Seed Germination of *Shortia galacifolia*

Temperature and Moisture	Number of Seeds Germinated After 50 Days (300 seeds/treatment	
	Light	Dark
10° C		
Abundant	0	0
Sufficient	0	1
Deficient	0	0
20° C		
Abundant	26	2
Sufficient	13	0
Deficient	0	0
30° C		
Abundant	1	0
Sufficient	0	0
Deficient	0	0
Changing temperature		
Alternating 10°, 20°	4	
Increasing 10° to 20° to 30° to 22°	3	
Constant 20°	13	

Using water with leaf litter in it instead of plain distilled water may have improved germination slightly, but using water with moss or glacial acetic acid added did not. Better germination was obtained for all soaking treatments than for the control, and the period of soaking had no effect.

The average moisture content of Shortia seeds before they were air dried was 12% oven-dry weight. No loss of germinative capacity occurred for seeds air-dried for up to 6 days. However, no loss of moisture occurred, because the vapor pressure deficit of the air remained low over the whole period. A separate set of 100 seeds was made up to be left until a significant amount of moisture was lost. The seeds were allowed to air-dry for about 3 days. Since no moisture loss had occurred after this time, the seeds were put in an oven at 30°C for 12 hours. Their weight was reduced 4% during this treatment, which was three times the weight lost by any of the air-dried lots of seeds. After removal from the oven, the seeds were left in the air for 20 days.

They had regained their original weight when they were put on moist filter paper to test germination. None of the seeds germinated.

For 21 treatments the number of seeds germinated was recorded every 4 days. For most of the treatments the first germination occurred between 13 and 16 days from the start. Soaking caused germination to begin 4 to 8 days earlier.

The distribution of germination over the 32 day period followed no particular pattern. A final count for all treatments was made after 50 days, and a few germinations were recorded at this time. Most germinations, however, had occurred before 32 days.

Seeds of *Shortia galacifolia* germinated in the laboratory under a wide variety of conditions, indicating that the seeds do not have to be in the capsule to germinate. The factors which appear to be most significant in influencing germination of Shortia seeds are temperature, moisture, light, and presence of capsule parts.

The optimum temperature for germination is probably around 20°C, because substantially more germination occurred at this temperature than at either 10°C or 30°C.

An abundant moisture supply is necessary for good germination. No seeds germinate when moisture is always deficient, but some may germinate when moisture is alternately available and unavailable. Although the evidence is not conclusive, it also appears that Shortia seeds lose their germinative capacity if their moisture content falls below a certain critical level, even if they later regain moisture. Soaking seems to improve germination slightly, and even 9 days of soaking does not impair germination.

Light appears to be beneficial for germination, since many more seeds germinated with 900 ft-c illumination than in the dark or with 30 ft-c.

Although any capsule part improved germination when present with the seeds, combining parts did not produce a cumulative effect. Using leachate from leaf litter to water the seeds did not improve germination as much as the

presence of capsule parts, indicating that there is some organic substance peculiar to Shortia which aids germination.

From the results of the various tests it might be predicted that the best germination of Shortia seeds would be obtained by soaking the seeds at least 1 day, using sand as a substrate with capsule parts scattered over the sand, providing an illumination of about 900 ft-c, and supplying abundant moisture. Combining the two treatments which gave the best germination, "addition of placenta" and "20°C-light-abundant moisture," was tried, but no increase in percentage of germination resulted.

Although germination of Shortia seeds in nature outside the capsule has never been observed, the results of the laboratory experiment indicate that it undoubtedly occurs. Factors which were found to be important for good germination in the laboratory are present in the natural habitat. Microenvironmental measurements made in several different stands of Shortia show that the air temperature during the growing season ranges from 13°C to 32°C, that the relative humidity never falls below 50%, and that the light intensity ranges from 20 to 1000 ft-c (Vivian, 1965). Decaying capsule parts and leaf litter are present on a sandy soil.

In 1936, Ross thought the answer to the extreme localization of Shortia was the fact, that the seeds are held tightly in the open capsule and must germinate there, thus limiting the spread by seed. Although Ross noted that some seeds fall from the capsules, he did not mention how many. The author has observed that 50% or more of the seeds may be lost within a month after the capsules open. Rain is probably the primary agent in releasing the seeds, which could easily be carried far from the mature plants by rivulets or streams. It does not seem that lack of seed dispersal can be used to explain why Shortia fails to colonize new, apparently suitable habitats. Low seedling survival may be much more important in limiting the spread of Shortia by seed. Observations suggest that the seedlings grow very slowly in nature and are quite subject to winter kill (Vivian, 1965). Seeds germinated in the laboratory produced seedlings about

2 cm high after 8 months of growth. The amount of competition that seedlings can tolerate is probably small. It seems that the problem of the restricted and discontinuous distribution of *Shortia galacifo*lia has not been solved, but that requirements of mature plants, competition, and seedling survival, perhaps along with a low percentage of germination, are more significant factors than lack of seed dispersal.

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THE APPLICATION OF THE LINNAEAN NAMES OF SOME NEW WORLD SPECIES OF EUPHORBIA SUBGENUS CHAMAESYCE

DEREK BURCH

In 1960 Wheeler resurrected a subject which most workers in the *Euphorbiaceae* must have thought long since settled. His proposal, in 1939, to change an established and well understood usage of the name *Euphorbia maculata* L. stirred up a controversy which had died down in print by 1948 (Svenson 1945; Fosberg 1946, 1947; Croizat 1947, 1948), and which Fosberg's rejustification of his earlier stand failed to revive in 1953. In 1962 Croizat answered Wheeler's case with what should have been the final word on the subject, but in the course of a revision of the genus *Chamaesyce* in the Caribbean it has been brought home to me that confusion still exists in American herbaria, and that some collectors are following Wheeler's suggestion even though the case for the change was never proved.

If this were the only Linnaean name whose application to a New World species of *Euphorbia sensu lato* had been questioned the matter would best be allowed to lie, but there are other situations to clarify and, since some of them depend on the use of *E. maculata*, I have reluctantly decided to drag the old bones of the argument out once more.

The other areas which must be discussed are the names for a group of erect, large-leaved plants including *E. hypericifolia* (the name which Wheeler refers to as a "pandora's box" — presumably with some knowledge since he was the last to force its lid closed); the confusion between the Caribbean *E. prostrata* and *E. chamaesyce* of the Old World, and finally a note on the application of the name *E. thymifolia* L. In the interests of brevity, only the relevant parts of earlier papers will be discussed.

Most of the confusion in applying the names proposed by Linnaeus stems from a difference in interpretation of the relative importance of the parts of the material on which

his description was based. Both Svenson (1945) and Stearn (1957) have published very lucid accounts of his descriptive method, pointing out the importance of the phrase-name, not only as a partial characterization of the plant but also as a key to the genus when taken in conjunction with the polynomials of the other species. These phrases were revised to maintain this differentiating function as new material or information was received, and the superseded phrases were put into synonymy.

A mistake commonly made in deciding the application of a Linnaean name is to confuse the need to establish the concept of species which was in the author's mind with the present-day wish to have a single specimen as a representation of the name given to the species. Linnaeus did not work with "type specimens", but based his species on an aggregate of earlier descriptions, illustrations, and actual material. It must be left to a worker familiar with the group, and having a clear understanding of the Linnaean method, to decide just what elements were included by Linnaeus in composing his polynomial phrase-name. Only when this has been done should the specimens now in the herbarium, which may or may not have been present when the *differentiae* were drawn up, be considered in the light of the International Code for designation as types of the names.

1. The application of *Euphorbia maculata* L.

The species to which Linnaeus gave the trivial name "maculata" is number 21 in *Species Plantarum* edition 1. The full entry is made up of the usual polynomial phrase-name and references to earlier works (in this case a description and illustration by Plukenet), an indication of habitat, and also a supplementary description including characters such as color which Dandy suggests to mean that it was taken from fresh material (personal comm. 1964). The author's concept, then, we know to be based on a plant which Plukenet described and illustrated, with the phrase-name rewritten to be comparable with others in the genus, and probably to include information taken from a specimen.

These are the facts in the case, and from this point we move into conjecture.

For many years the name *E. maculata* has been applied to a prostrate plant, a specimen of which is in the Linnaean Herbarium on sheet number 630-11. The sheet is marked "21 maculata", which agrees with the entry in *Species Plantarum*. Most authors have taken the number to be one written on the sheet by Linnaeus, although Savage (1945), in his invaluable catalogue of the herbarium, ascribes it to Sir J. E. Smith. When I examined the specimens last summer I was unable to decide between these two viewpoints, but, in any case, there is general agreement that the epithet "maculata" on the sheet was added by Smith.

There is another sheet, 630-4, on which Linnaeus wrote "17 Euphorbia maculata". In *Species Plantarum* number 17 is the species to which the trivial-name "hypericifolia" was given, and the specimen on the sheet is of one of a group of superficially similar erect species to which Linnaeus applied this name. It is clear that the number and the name on this sheet are contradictory, and that Linnaeus was mistaken in writing one or the other. The choice of which is in error is the first matter for conjecture, but in reaching a decision it should be borne in mind that the number was part of a major work which was in progress or had recently been completed (for it is not certain when the annotation on the sheet was made), while the name was, literally, a trivial name — a new, "shorthand" way of referring to a species, the use of which may still have been unfamiliar to Linnaeus. Wheeler, however, chooses to regard the trivial name as correct, the number as wrong, and on this builds the whole case for his application of the name. In effect, he first selected his type specimen, and then showed that it is feasible that it might have fitted Linnaeus' concept of the species.

Let us instead examine the entry in *Species Plantarum*, keeping in mind the two entities which have been offered as candidates for the name. The polynomial specific name, which was designed to separate the species from all others

rather than as a description, contains no features which positively identify or disqualify either plant. Wheeler was correct in omitting this as a factor in his argument. Consider, however, the position of the species in the genus. Linnaeus was a methodical worker, and his purpose was to distinguish between the discrete groups that he considered species. What better way is there of doing this than by arranging similar things together, and then pointing out the features in which they differ? It is not suggested that Linnaeus followed this plan with complete consistency, but Croizat (1962) has shown in convincing detail that his genus *Euphorbia* is laid out in this fashion. The succulent species fall in the early part, followed by the shrubby types, while in the section *Dichotomae*, species 16-26, the arrangement is even more systematic. Species 16 through 19 are of erect or ascending habit with serrate leaves, species 20 through 24 are prostrate and have various leaf margins, and species 25 and 26 are erect with entire leaves. The placement of 21 *maculata* between 20 *thymifolia* and 22 *prostrata* is strong evidence that the traditional application of the name to the prostrate plant is the correct one to follow.

The descriptive phrase of Plukenet is noncommittal for our purpose of deciding between the two species, and I would agree with Wheeler that the illustration must also be rejected as a decisive factor. However, I feel that he is rash in seizing on features of the italicized description that follows the note on the habitat in *Species Plantarum* to support his choice of a type specimen on which to base the name. In his most recent article (1960) he persists in assuming that one of the two now in the Linnaean Herbarium must be treated as a type specimen in the modern sense. Even if these sheets were in Linnaeus' possession at the time of writing *Species Plantarum*, Wheeler's choice of one over the other because it agrees with parts of the description may be countered by reference to other characters which would support the opposite choice. The shape of the leaves, and the description "subpilosa", for example,

are each more appropriate to the specimen of the prostrate plant on sheet 630-11 than to the other.

Nothing in the original entry in *Species Plantarum*, then, gives grounds for changing the application of the name, and there is sufficient doubt about Linnaeus' view of the specimens now in the herbarium for them to form an unreliable basis for such a drastic step. On the other hand it has been shown that the layout of *Species Plantarum* gives a positive reason for not making such a change, and the application to the prostrate species, affirmed by Jacquin's plate in 1772 and adopted by the vast majority of subsequent authors, should be maintained.

There is one further point that must be discussed before this matter may finally be laid to rest. Both Wheeler (1939, 1960) and Fosberg (1946, 1953), who correctly apply the name *E. hypericifolia* to an erect plant, take the statement "*Euphorbia maculata* similis *E. hypericifoliae*" by Linnaeus in the *Mantissa Altera* (1771) to be selection of the erect element from the two which they feel he had earlier combined under the name *E. maculata*. Croizat's dismissal of this as an irrelevancy (1947, 1948) was not satisfactory, but it was not until I had the opportunity to examine some of the books in the Linnaean Library that I found a reasonable explanation. One of the first books to use differential phrase-names in the manner of Linnaeus was Patrick Browne's *Civil and Natural History of Jamaica* (1756). Stearn (1957) reports that this delighted Linnaeus, who went through the book providing (for his own use in later publications) the *nomina trivialia* that Browne had thought it unnecessary to give. Browne's "Euphorbia 2. Minima reclinata, foliolis ovatis denticulatis . . ." gives as synonym the same "Tithymalus erectus acris . . ., Sloane Cat. 82, & H. t. 126" that Linnaeus included in his 17. *hypericifolia*. In recognition of this, "*E. hypericifolia*" has been written in the margin of this entry, probably by Linnaeus himself. Browne goes on to describe his plant ". . . it is a slender weakly creeper and seldom runs above three or four inches from the root; its branches are smooth and slender and the

leaves small and oval". Here, then, is the basis for the statement in the *Mantissa*. Linnaeus knew "maculata" to be a prostrate plant, and, on reading Browne's description of the plant based on the same element as his "hypericifolia" as a creeper, he simply drew attention to this similarity of habit.

2. The application of the name *Euphorbia hypericifolia* L., and the names for the group of morphologically similar species.

This group, with strong, spreading to erect stems and leaves which are usually toothed, includes at least four species in America. They are distinguishable on pubescence, size of capsule, and on stipule and seed-coat characters, and have somewhat distinct geographical distributions. The names under which they have been known may be summarized thus:

Entity A — northern plant with pubescence only in lines on stem; cyathia never glomerulate; capsules large; seed coat rippled . . . *Euphorbia nutans* Lag.; *E. preslii* Guss.; *E. hypericifolia* L. *sensu* Michaux, Torrey; *E. maculata* L. *sensu* Wheeler.

Entity B — plant of the southern United States to South America; rarely and sparingly pubescent; cyathia never glomerulate; capsules large; seed coat transversely ridged . . . *E. hyssopifolia* L.; *E. brasiliensis* Lam.; *Chamaesyce nirurioides* Millsp.; *C. jenningsii* Millsp.

Entity C — tropical or subtropical plant; rarely pubescent; cyathia glomerulate; capsules small; seed coat wrinkled . . . *E. hypericifolia* L.; *E. pilulifera* L.; *E. glomerifera* (Millsp.) L. C. Wheeler.

Entity D — tropical plant with all herbage close-pubescent; cyathia never glomerulate; capsules large; seed coat transversely ridged . . . *E. lasiocarpa* Klotzsch; *E. hypericifolia* L. *sensu* Wheeler.

The central problem here is the application of the name *E. hypericifolia* L., which has been widely used for both Entity A and Entity C, and which Wheeler proposed in 1939 for Entity D.

Entity B need not be involved in this discussion. It was described by Linnaeus in *Systema Naturae* edition 10 (1759) with the trivial name *hyssopifolia*, and this has been consistently applied by all authors except those who divided the taxon on the basis of leaf shape. Examination of a long series of this highly variable species has so far failed to

substantiate any such division, and the name *E. hyssopifolia* L. should probably be applied throughout.

Wheeler's case for the application of the name *E. hypericifolia* to the pubescent West Indian species, Entity D, was made at a time when neither the Linnaean specimens nor Savage's catalogue was available for study. He examined photographs of the two sheets in the herbarium labelled "hypericifolia," and, having disposed of sheet 630-4 as the type of *E. maculata* L. in the fashion discussed above, he selected the second sheet, 630-3, as the type of the epithet *hypericifolia*. He correctly identified the specimen on this sheet as an example of Entity D, and proposed that the epithet be used for this species. The sheet, however, is marked "Br," indicating that it came from Patrick Browne, most of whose collections were not added to the herbarium until 1758 (Stearn, 1957), and, thus, could not have been considered by Linnaeus when he described his *E. hypericifolia*. Wheeler's proposal may be rejected on these grounds alone.

Entity D was first described by Klotzsch in 1843 under the specific name *E. lasiocarpa*. Grisebach, in his *Flora of the British West Indian Islands* (1864), reduced the taxon to varietal level under *E. hypericifolia* L., but there has been general agreement that it merits specific rank, and that the name used by Klotzsch should be maintained.

The question of the application of "hypericifolia" should also be approached by considering the entry in *Species Plantarum*. The polynomial phrase-name is taken without alteration from Wiman's *Euphorbia, ejusque Historia . . .*, a dissertation published under the supervision of Linnaeus in 1752. The entry here includes even more synonyms than are carried over into *Species Plantarum*, and also a description which makes it clear that a variety α, with almost solitary "flowers", and another β, with "flowers" collected into heads, were recognized and included in the concept of the species. Variety α is probably Entity A, which appears to be the plant described in most of the earlier works of Linnaeus given here as synonyms. Variety β is easily recog-

nisable as Entity C, and this was the plant described and illustrated by Sloane as "Tithymalus erectus acris . . ." and by Commelin as "Tithymalus Africanus, seu Peplis major Brasiliensis . . ." (fide Tab. 10, "Tithymalus Americanus, flosculis albis") to which reference is made in the synonymy. It is clear that Linnaeus held a broad concept of *E. hypericifolia* at the time of publication of Wiman's work and *Species Plantarum*, since the polynomial phrase-name of his earlier works was expanded in these to include features of Sloane's plant.

In a case such as this, where the elements included by Linnaeus are now considered to form more than one species, Stearn (1957) suggests that the choice as to which is to bear the name should take into account not only all parts of the type material, but also the author's intent, and, if possible, subsequent and current usage. We have seen that both Entity A and Entity C are represented in the synonymy, and that while Entity A was the first to be described, this is balanced by the later broadening of the description to include Entity C. There is little in the entry in *Species Plantarum* to guide the choice, and no indication of the author's intent. The usage of the names, however, is another matter. Sir J. E. Smith, who acquired the herbarium in 1783, favored Entity A (Torrey, 1843), and his example was followed by Michaux (1803), Torrey, and a few early American authors. With these exceptions there has been an overwhelming use of *E. hypericifolia* as the name for Entity C, including Crantz' *Institutiones Rei Herbariae* (1766), Miller's *Gardener's Dictionary* edition 8 (1768), Aublet's *Histoire des Plantes de la Guiane Française* (1775), Humboldt's *Nova Genera* . . . (1817), Hooker's *Exotic Flora* (1823), and Boissier in DC. *Prodromus* (1862). In fact, the usage is so firmly established that it would be very much against the interests of stability of nomenclature to consider making any change, and the name *E. hypericifolia* L. should continue to be applied to this subtropical, erect plant with small capsules usually borne in glomerules. Sloane's illustration, cited by Linnaeus in *Species Plantarum*, is an ap-

propriate lectotype for the name used in this fashion, and the specimen on which the illustration was based, if it still exists in the Sloane Herbarium in the British Museum, would constitute what Dandy has referred to as a "typotype" (Stearn, 1957).

The name for Entity A remains to be decided. The varietal status accorded it by Linnaeus was not questioned for a number of years, but in 1816 Lagasca described a taxon under the specific name *E. nutans*. Wheeler (1941) reports that he examined a specimen which probably represents the plant that Lagasca described, and concluded that the name was apparently based on unusually vestite plants of Entity A. On these grounds the name *E. nutans* Lag. will be adopted for this species, with the more commonly used but later name *E. preslii* Guss. passing into synonymy.

In summary, then, the names for this group of species are as follows:

Entity A (Northern plant with large capsules) — *E. nutans* Lag.
Entity B (Southern plant with large capsules) — *E. hyssopifolia* L.
Entity C (Tropical plant with small capsules) — *E. hypericifolia* L.
Entity D (Tropical plant which is densely pubescent) — *E. lasiocarpa* Klotzsch.

3. *Euphorbia prostrata* Ait. and *E. chamaesyce* L.

Wheeler suggested in 1941 that these two species are conspecific, basing his case on the fact that one of the two sheets labelled "chamaesyce" in the Linnean Herbarium (sheet 630-17) is actually a specimen of the plant which has been known as *E. prostrata* Ait. This sheet, however, is another of Brown's specimens, and was not in Linnaeus' possession until long after his description of *E. chamaesyce* in *Species Plantarum*. The other sheet (630-15) is a good example of the European species to which the name has usually been applied, and nothing in the original entry suggests that Linnaeus intended the limits of his species to be set broad enough to include the West Indian plant.

The two species are, in fact, quite distinct, and the annotation by Linnaeus on sheet 630-17 is a simple misidentification. Croizat (1945) has documented the consistent use of the two names for the distinct entities, and there seems

little room for argument against maintaining *E. chamaesyce* L. as the name for a Mediterranean plant not so far found in the New World, and *E. prostrata* Ait. as the name for a weed of the Old and New World tropics. Wheeler accepts this usage in a supplement to the second edition of Kearney & Peebles *Arizona Flora* published in 1962, but his correction has been overlooked by the authors of other floras which have appeared since that date.

4. Application of the name *E. thymifolia* L.

Wheeler (1941) drew attention to a suggestion by A. Gray that the specimens 630-10 "Euphorbia 20 thymifolia" and 630-11 in the Linnaean Herbarium are of the same entity. An examination of the sheets confirmed this, and that both are the prostrate *E. maculata* L. There is no specimen in the Herbarium of the plant which has traditionally been called *E. thymifolia* L., and the protologue in *Species Plantarum* is of little direct help in deciding the application of the name. The polynomial phrase-name and descriptions by Burmann and Plukenet indicate that the plant is prostrate and pubescent, with serrate leaves and "flowers" somewhat collected into groups, and the illustrations cited fit these descriptions but show no characters which are diagnostic.

Burmann, however, includes in his synonymy "Chamaesyce, Sloane Cat. 83". This was based on a specimen from St. Jago de la Vega, now in the Sloane Herbarium, which is cited by Fawcett and Rendle in *Flora of Jamaica* (1920) as an example of *E. thymifolia* L. in the sense in which the name is used by most authors. This gives a positive link between the name and a well-understood taxon, and since no other such link can be made, and since nothing in the protologue contradicts this usage, it seems reasonable to accept it even though Sloane's plant was probably not seen by Linnaeus (Stearn, 1957).

The plant to which this name has been applied is found in most tropical regions, and is distinguished from similar species by the shortness of the stalk of the female flower, which forces the cyathium to split down one side as the

capsule develops. Bernard, *Icones Bogorienses,* 4, t. 315. 1910, illustrates this character well. Grisebach, in his *Flora of the British West Indian Islands* (1864), treats the taxon as a variety *thymifolia* of *E. maculata* L., but Boissier in DC. *Prodromus* (1862), Drury in *Handbook of the Indian Flora* (1869), Urban in *Symb. Antill.* (1910), and most subsequent authors consider that it merits specific rank. This usage is now so widespread and so well understood that nomenclatural stability will be best served by maintaining it, unless some contrary intention on the part of Linnaeus can be shown.

MISSOURI BOTANICAL GARDEN,
ST. LOUIS, MISSOURI

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IDENTITY OF WITCHWEED IN THE SOUTHEASTERN UNITED STATES

In 1956 witchweed was found to be parasitizing field plantings of corn (*Zea mays* L.) in North Carolina and South Carolina. Because potential loss from this infestation is severe, immediate steps were effectively taken to prevent the spread of the parasite. The original specimens were tentatively identified as *Striga asiatica* (L.) O. Kuntze. The botanical nomenclature of this genus has been subject to interpretation by the various botanists who have dealt with it and only recently has an effective review been written (Saldanha, C. J. 1963).

In late 1964, Dr. V. P. Rao, a visitor from India, questioned the identification of the witchweed in the United States. He kindly furnished a copy of the Saldanha paper and a suite of specimens identified by Saldanha with which the local *Striga* could be compared. No doubt remains that this plant is *Striga lutea* Lour., which includes one of the elements of *S. asiatica,* a name now abandoned as a source of confusion.

However, Rao writes (in a personal communication) ". . . . the species found in the United States has red flowers which I have never seen in the common witchweeds which we come across in this country [India]." While it is true that the bulk of the population in the United States has very bright chinese-red flowers, individuals with lemon yellow flowers occasionally appear. Rarely an individual plant is found in which the flowers are yellow with red marks or stripes. Perhaps the flower color is due to the original introduction of red-flowered plants from Kottayam, India, where a population is known, or from South Africa, where the bulk of the plants of this species are said to be red-flowered.

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BROMUS MOLLIS AND ALLIES IN NEW ENGLAND

FRANK C. SEYMOUR

A problem like that in many other species is presented by *Bromus mollis* L., in which confusion has arisen because of unrecognized species, varieties, or forms. Apparently this species has been interpreted as including all specimens with short peduncles and hairy lemmas. In its form with glabrous lemmas, it has often been confused with *B. racemosus* L., and the form of *B. commutatus* Schrader with hairy lemmas has often been mistaken for typical *B. mollis*.

To Mr. Peter S. Green of the Arnold Arboretum I am indebted for calling my attention to the presence, in New England, of more than one species commonly included in *Bromus mollis*, for lending me a key which set apart neglected or little recognized taxa, and for making very valuable suggestions regarding this article. To him I express my hearty thanks. I thank Dr. Richard A. Howard, Director of the Arnold Arboretum, and Dr. Reed C. Rollins, Director of the Gray Herbarium, and Mr. Richard J. Eaton, Curator of the Herbarium of the New England Botanical Club, for the privilege of referring to specimens deposited in their institutions. I appreciate very much the help of Dr. Robert C. Foster, of the Gray Herbarium, and Dr. Lily M. Perry and Mr. Green, of the Arnold Arboretum, in finding references for original descriptions. I thank Mrs. Lazella M. Schwarten for the facilities of the Harvard Herbarium Library, and Dr. C. E. Hubbard of the Royal Botanic Gardens, Kew, England, for the reference for *B. commutatus* Schrader var. *pubens* Wats. Appreciation is expressed also to Dr. Howard W. Pfeifer, of the University of Connecticut and Mr. Leopold A. Charette, until recently of Yale University, for citations of specimens in their respective institutions.

In 1833, Hardouin (Congr. Sci. France *1:* 59. 1833) proposed a new name, *Bromus Thominii*, for a grass which had previously been described and named *B. arenarius*

Thomine-Desmasures (Mem. Soc. Linn. Calvados *1:* 40. 1824) because Labillardière had used the name *B. arenarius* for another species in 1804. However, many botanists have considered this species not sufficiently distinct from *B. mollis*; and in America, where it has been introduced, it has commonly been overlooked or ignored to the present time. In 1924, another segregate of *B. mollis* was recognized at specific rank, namely *B. lepidus* Holmberg (Botaniska Notiser *1924:* 326.).

Plants differing from the typical by having, or lacking, pubescence on the lemmas occur in these species and have often been treated as varieties. Here, the example of Fernald and Holmberg is followed by reducing them to forms. When a taxon differs from the typical variant in only one character and does not seem to have a distinct geographic range, it seems more appropriate to recognize it as a form rather than a variety.

Much of the confusion in these species arises from the fact that all three of them and also *Bromus commutatus* Schrader and *B. secalinus* L. may have either glabrous or hairy lemmas. Consequently, pubescence on the lemmas, or lack of it, does not separate these species. In an effort to clarify this group and some others to which they are closely related, the following key is presented, dealing with all the New England species in the sections Bromium Dum. in the Manual of Grasses of the United States by A. S. Hitchcock, ed. 2 by Agnes Chase, 1951, and Zeobromus Griseb. in Gray's Manual, ed. 8, by M. L. Fernald, 1950.

A. Branches of panicle short; peduncles all or mostly shorter than spikelets; panicle erect; margins of lemmas overlapping the lemma next to them.
  B. Lower lemmas 8-11 mm long; lower glume (6-)7-9 mm long; upper glume (7-)8-9 mm long. ..... 1. *B. mollis.*
    C. Lemmas hairy. ..... 1a. *B. mollis* f. *mollis.*
    C. Lemmas glabrous. ..... 1b. *B. mollis* f. *leiostachys.*
  B. Lower lemmas 5.5-7.5 mm long; lower glume 4.5-6 mm long; upper glume 5.5-6.6 mm long.
    D. Lower lemmas 6.5-7.5 mm long; lower glume 4.5-6 mm

long; upper glume 6-6.6 mm long; grain shorter than palea. ..... 2. *B. Thominii.*

E. Lemmas glabrous, except minutely scabrous margins. ..... 2a. *B. Thominii* f. *Thominii*

E. Lemmas hairy. ..... 2b. *B. Thominii* f. *hirsutus.*

D. Lower lemmas 5.5-6.5 mm long; lower glume 4.5-5 mm long; upper glume 5.5-6 mm long; grain longer than palea. ..... 3. *B. lepidus.*

F. Lemmas glabrous. ..... 3a. *B. lepidus* f. *lepidus.*

F. Lemmas hairy. ..... 3b. *B. lepidus* f. *lasiolepis.*

A. Branches of panicle longer; peduncles all or mostly longer than spikelets; panicle erect or drooping; margins of lemmas not always overlapping the lemma next to them.

G. Margins of lemmas inrolled at maturity, leaving axis visible; lemmas 6.5-9 mm long. ..... 4. *B. secalinus.*

H. Lower lemmas 7-9 mm long; sheaths glabrous. ..... 4a. *B. secalinus* var. *secalinus.*

I. Lemmas awnless. ..... 4c. *B. secalinus* var. *secalinus* f. *submuticus.*

I. Lemmas with awns 1-6 mm long.

J. Lemmas glabrous. ..... 4b. *B. secalinus* var. *secalinus* f. *secalinus.*

J. Lemmas hairy. ..... 4d. *B. secalinus* var. *secalinus* f. *hirtus.*

H. Lower lemmas 6.5-7 mm long, glabrous; lower sheaths hairy. ..... 4e. *B. secalinus* var. *hirsutus.*

G. Margins of lemmas concealing axis, not inrolled; lower lemmas 6.5-12 mm long.

K. Lower lemmas 6.5-8(-9) mm long.

L. Anthers 3-4.5 mm long; upper lemmas about as long as lower; panicle open, its branches spreading, lower branches more than two at a node, each bearing two or more spikelets; lower sheaths hairy, upper sheaths glabrous. ..... 7. *B. arvensis.*

L. Anthers 2-2.5 mm long; upper lemmas distinctly shorter than lower; panicle rather dense. its branches erect or ascending, lower branches 1-2 at a node, each bearing 1 (rarely 2) spikelets; sheaths all hairy. ..... 5. *B. racemosus.*

K. Lower lemmas 9-12 mm long.

M. Spikelets drooping, 0.8-1.3 cm wide, awnless or nearly so; anthers 0.8-1 mm long; branches of panicle usually bearing 1 spikelet; lower lemmas about as wide as long; palea much shorter than lemma, about 6 mm long. ..... 8. *B. brizaeformis* Fischer & Meyer

M. Spikelets erect or ascending, 4.5-6 mm wide; awns usually 4-10 mm long; anthers 1.5-2 mm long; branches of panicle usually bearing 2 or more spikelets; lower (and other) lemmas much longer than wide; palea about as long as lemma. ..... 6. *B. commutatus.*
N. Lemmas glabrous except minutely scabrous margins. ..... 6a. *B. commutatus* f. *commutatus.*
N. Lemmas hairy. ..... 6b. *B. commutatus* f. *pubens.*

To assist further in identifying these species, a few representative specimens are cited. *Bromus mollis* is too familiar to require citations; likewise the typical forms of some other species. It will be evident from the list that in America *B. Thominii* f. *hirsutus* also is frequent whereas the other species and forms most closely related to them are less common.

1. Bromus mollis L. Sp. Pl. ed. 2. 112. 1763.
1a. Bromus mollis f. mollis.
1b. Bromus mollis f. leiostachys (Hartman) Fernald, Rhodora **35**: 316. 1933.
In this article Fernald makes clear the reasons why this infraspecific epithet must be used instead of *leptostachys* of Persoon.
REPRESENTATIVE SPECIMENS. MASSACHUSETTS: Roxbury, 1878, *E. Faxon* (VT); Lancaster, 1 July 1943, *F. C. Seymour 7240* (NEBC). CONNECTICUT: Fairfield, 12 June 1914, *E. H. Eames 8753* (GH). NEW JERSEY: Camden, 3 June 1877, *Parker* (GH). DISTRICT OF COLUMBIA: Washington, 31 May 1905, *A. S. Hitchcock,* Am. Grasses 891 (GH), distributed as *B. racemosus* L., see Rhodora **35**: 316. 1933. MICHIGAN: near Lansing, 22 June 1886, *L. H. Bailey, Jr.* (GH). IDAHO: New Plymouth, 21 May 1910, *J. F. Macbride* 94 (GH). OREGON: without precise locality, *Elihu Hall* 1871 (GH).

2. Bromus Thominii Hardouin, Congr. Sci. France **1**: 59. 1833.
2a. Bromus Thominii f. Thominii.
REPRESENTATIVE SPECIMENS. MASSACHUSETTS: Stockbridge, 25 July 1914, *R. Hoffmann* (NEBC). RHODE ISLAND: Block Island, 12 Aug. 1919, *C. B. Graves* (NEBC). CONNECTICUT: Bridgeport, 24 June 1915, *E. H. Eames* 9022 (NEBC). BRITISH COLUMBIA: Vancouver Island, 20 June 1907, *C. O. Rosendahl* 1887 (GH).
2b. Bromus Thominii f. hirsutus (Holmberg) Hylander, Uppsala Univ. Arskr 1945 (7): 85. 1945.
REPRESENTATIVE SPECIMENS. MAINE: Seal Harbor, Mt. Desert Island, 9 July 1928, *G. L. Stebbins, Jr.* 327 (NEBC); N. Berwick, 4 July 1892,

J. C. Parlin (GH, NEBC). MASSACHUSETTS: Salem, 26 May 1890, *W. P. Conant* (NEBC); Cambridge, 10 June 1891, *M. L. Fernald* (NEBC); Lincoln, 16 June 1913, *M. L. Fernald* (NEBC); Boston, Parker's Hill, June 1877, *C. E. Faxon* (GH); Centerville, 17 June 1896, *E. F. Williams* (NEBC); Nonamesset, 29 May 1928, *J. M. Fogg, Jr. 3394* (NEBC); Penikese, 3 July 1928, *J. M. Fogg, Jr. 3412* (NEBC); Chilmark, 23 Aug. 1895, *Sydney Harris* (NEBC); Nantucket, 15 June 1909, Mrs. *N. F. Flynn* (VT). RHODE ISLAND: Block Island, 30 June 1938, *K. P. Jansson* (CONN). CONNECTICUT: New London, 1891, *C. B. Graves* (GH); 16 June 1932, *K. P. Jansson* (CONN); Hartford, 2 June 1901, *A. W. Driggs* (GH). NEW YORK, Long Island, Orient Point, 26 July 1940, *K. P. Jansson* (CONN). MICHIGAN: Meridan Twp. T4N, R1W sec. 7, Ingham Co., *G. W. Parmelee 231* (VT). ILLINOIS: Peoria, July 1904, *F. E. McDonald* (GH). NEVADA: King's Canon, *C. F. Baker 1104* (VT). CALIFORNIA: Mather, 30 May 1931, *D. D. Keck 1126* (GH); Redding, Shasta Co., 4 July 1914, *L. E. Smith* (GH); Webb Ranch, San Mateo Co., 5 May 1960, *D. M. Porter 678* (GH). WASHINGTON; Pullman, 8 July 1950, *L. C. Hulbert 499* (CONN).

3. Bromus lepidus Holmberg, Bot. Not. 1924: 326. 1924.

3a. Bromus lepidus f. lepidus.

REPRESENTATIVE SPECIMENS. MASSACHUSETTS: Stockbridge, 21 June 1915, *R. Hoffmann* (NEBC). CONNECTICUT: Bridgeport, 24 June 1915, *E. H. Eames* (VT).

3b. Bromus lepidus f. lasiolepis Holmberg, Bot. Not. 1924: 326. 1924. Syn. f. *micromollis* (Krösche) Holmberg in Hartman, Handb. Skand. Fl. ed. Holmberg, 265. 1926.

REPRESENTATIVE SPECIMEN. MASSACHUSETTS: Jamaica Plain, 19 June 1963, *P. S. Green* 49/63 (NEBC).

4. Bromus secalinus L. Sp. Pl. 76. 1753.

4a. Bromus secalinus var. secalinus.

4b. Bromus secalinus var. secalinus f. secalinus

4c. Bromus secalinus var. secalinus f. submuticus (Reichenb.) Ascherson & Graebner, Syn. Mittelleurop. Fl. 2(1): 604. 1901.

REPRESENTATIVE SPECIMENS. MAINE: E. Auburn, 1 Sept. 1897, ex. herb. *E. B. Chamberlain* (NEBC); N. Berwick, 26 June 1896, *J. C. Parlin* (NEBC). MASSACHUSETTS: Jamaica Plain, 6 Aug. 1925, *E. J. Palmer 28164* (NEBC); New Bedford, s.d., *E. W. Hervey* (NEBC). CONNECTICUT: West Haven, 30 June 1903, *R. W. Woodward* (NEBC).

4d. Bromus secalinus var. secalinus f. **hirtus** (F. Schultz) Seymour, stat. nov. Basionym: *B. mutabilis* F. Schultz var. *hirtus* F. Schultz, Flora 32: 234. 1849. Synonym: *B. secalinus* L. var. *hirtus* (F. Schultz) Ascherson & Graebner, Syn. Mitteleurop. Fl. 2(1): 604. 1901.

REPRESENTATIVE SPECIMENS. MAINE: Bethel, 25 June 1938, *L. A. Wheeler* (NEBC). CONNECTICUT: Southington, 26 June 1903, *C. H. Bissell* (NEBC).

4e. Bromus secalinus var. hirsutus Kindberg, Bot. Not. 1887: 32. 1887.

REPRESENTATIVE SPECIMENS: VERMONT: Townshend, 23 June 1912, *L. A. Wheeler* (NEBC). MASSACHUSETTS: Revere, 1878, *H. A. Young* (NEBC); Needham, 30 July 1883, *T. O. Fuller* (NEBC); Milton, 15 July 1918, *N. T. Kidder* (NEBC); Hingham, 11 July 1926, C. H. *Knowlton* (NEBC). RHODE ISLAND: Edgewood, 26 June 1913, *T. Hope* (NEBC). CONNECTICUT: Waterbury, 14 July 1910, *A. E. Blewitt 160* (NEBC).

5. Bromus racemosus L. Sp. Pl. ed 2. 114.

REPRESENTATIVE SPECIMENS: MAINE: Foxcroft, 25 June 1894, *M. L. Fernald* 565 (NEBC); Seal Harbor, 9 July 1928, *G. L. Stebbins, Jr. 326* (NEBC); 29 June 1899, *E. L. Rand* (NEBC). MASSACHUSETTS: Charlestown, 19 Aug. 1879, *C. E. Perkins* (NEBC); Brookline, 14 June 1883, *C. W. Jenks* (NEBC); Nantucket, 21 June 1910, *E. P. Bicknell 9773* (NEBC).

6. Bromus commutatus Schrader, Fl. Germ. 1: 353. 1806. Synonym: *B. pratensis* Erhart ex Hoffm. Deutschl. Fl. ed. 2. 2: 52. 1800, non Lamarck 1783.

6a. Bromus commutatus f. commutatus.

6b. Bromus commutatus f. **pubens** (Wats.) Seymour, stat. nov. Basionym: *B. commutatus* Schrader var. *pubens* Wats., Phytologist 1: 1062. 1844.

REPRESENTATIVE SPECIMENS: MAINE: N. Berwick, 27 June 1897, *J. C. Parlin 849* (NEBC). VERMONT: Ely, 27 June 1935, *A. A. Beetle 37* (NEBC). MASSACHUSETTS: Milton, 8 June 1924, *N. T. Kidder* (NEBC). CONNECTICUT: North Haven, 30 June 1962, *R. J. Eaton* 2 June 1909 & 18 June 1910, *E. P. Bicknell* (NEBC).

7. Bromus arvensis L. Sp. Pl. 77. 1753.

REPRESENTATIVE SPECIMENS: MASSACHUSETTS: Arnold Arboretum, 8 June 1942, *E. J. Palmer 46002* (NEBC); Grafton, 30 June 1951, *B. N. Gates 27059* (NEBC); Worcester, 10 July 1946, *B. N. Gates 20499* (NEBC). CONNECTICUT: North Haven, 30 June 1962, *R. J. Eaton* (NEBC); Bridgeport, 1 July 1912, *E. H. Eames 8543* (NEBC); Bridgeport, 10 July 1912, *E. H. Eames 8568* (NEBC).

8. Bromus brizaeformis Fischer & Meyer, Ind. Sem. Hort. Petrop. 3: 30. 1837.

REPRESENTATIVE SPECIMENS: VERMONT: Charlotte, 27 June 1880,

C. G. Pringle (VT). MASSACHUSETTS: South Boston, 28 May 1879 & 8 June 1879, *C. E. Perkins* (NEBC); Charlestown, 23 July 1881, Herb. *C. W. Swan* (YU); New Bedford, 15 July 1903, Herb. *E. W. Hervey* (NEBC). CONNECTICUT: East Haddam, 5 July 1903, *H. S. Clark* (NEBC); New Haven, 1884, *R. W. Woodward* (NEBC). WASHINGTON: *Pullman*, May 1898, A. D. E. Elmer 1330 (VT); Whitman Co., Karniak Mt., Willamette Mer. 20 July 1951, *L. C. Hulbert 2326* (CONN). ONTARIO: comte d'Haldimand, 2 July 1936, *F. Marie-Victorin, F. Rolland-Germain, F. Dominique 46200* (CONN).

PRINGLE HERBARIUM
UNIVERSITY OF VERMONT, BURLINGTON

CONTRIBUTION TO THE FUNGUS FLORA OF NORTHEASTERN NORTH AMERICA. IV[1]

HOWARD E. BIGELOW AND MARGARET E. BARR[2]

The following continues a report of unusual or rare species of higher fungi that we have collected in New England during recent years. In the summer of 1963 our field work was done in the White Mountains of New Hampshire, and during the summer and fall of 1964 we collected in the Mt. Mansfield area of Vermont. Although both years were generally dry in New England, sufficient moisture did accumulate at these two areas to produce a number of interesting species.

The senior author is responsible for the information on agarics, while the junior author has provided the data on ascomycetes. The colors within quotation marks are from Ridgway, R., 1912. Color Standards and Color Nomenclature. Washington, D. C. The collections are deposited in the Herbarium of the University of Massachusetts, Amherst, unless otherwise noted.

Recent research has been possible through the support of National Science Foundation Grant G-19534. We are grateful also to Mr. Stanley J. Smith, Senior Curator of Botany, New York State Museum, and Dr. I. MacKenzie Lamb of the Farlow Herbarium, for the opportunity to examine the type specimens cited. Mr. R. Goodrich, District Ranger, White Mountains National Forest, New Hampshire, and Mr. Perry Merrill, Commissioner, Department of Forests and Parks, State of Vermont, kindly extended permission for our collecting in New Hampshire and Vermont. We also wish to acknowledge the Research Council, University of Massachusetts for financial assistance with the cost of plates and reprints of this article.

[1]I. Rhodora **62:** 186-198. 1960. II. Rhodora **64:** 126-137. 1962. III. Rhodora **65:** 289-309. 1963. Contribution from the Department of Botany, University of Massachusetts, Amherst.

[2]Mrs. Howard E. Bigelow.

Plate 1331 *Callistosporium luteoolivaceum* (Berk. & Curt.) Singer. × 1.

BASIDIOMYCETES

Callistosporium luteoolivaceum (Berk. & Curt.) Singer, Lloydia **9:** 117. 1946. Plate 1331.

Agaricus luteoolivaceus Berk. & Curt. Ann. Mag. Nat. Hist. III, **4:** 286. 1859.

Agaricus coloreus Peck, Buffalo Soc. Nat. Sci. Bull. **1:** 46. 1873.

Agaricus rubescentifolius Peck, N. Y. State Mus. Rep. **39:** 38. 1886.

Collybia luteoolivacea (Berk. & Curt.) Sacc. Syll. Fung. **5:** 215. 1887.

Collybia colorea (Peck) Sacc. Syll. Fung. **5:** 230. 1887.

Collybia rubescentifolia Peck, N. Y. State Mus. Rep. **41:** 83. 1888.

Tricholoma rubescentifolium (Peck) Sacc. Syll. Fung. **9:** 15. 1891.

Collybia colorea var. *rubescentifolia* (Peck) Peck, N. Y. State Mus. Rep. **49:** 51. 1896.

Callistosporium psilocybe Murr. & Singer, Mycologia **36:** 363. 1944.

Pileus 1-4 cm. broad, convex at first with an inrolled and slightly incurved margin, expanding to broadly convex, finally plane, margin slightly inrolled for some time, exceeding gills at times, sometimes sulcate but not pellucid-striate, surface glabrous when moist, matted

fibrillose or innately radiate-fibrillose when faded, dull yellow at first becoming cinnamon to rufous brown ("orange cinnamon", "Hays russet", "brick red", "Brussels brown", "cinnamon rufous"), hygrophanous, fading to yellowish or buff (near "antimony yellow", "deep colonial buff", "light ochraceous salmon", "light ochraceous buff"), disc darkest; flesh thin, rather brittle, watery yellowish fading to pale yellowish or whitish, no odor and taste or taste rarely bitter.

Lamellae adnate or adnexed, finally emarginate then seceding, close, broad (up to 7 mm.), not forked or intervenose, arched at times, yellow ("empire yellow", "yellow ochre", "antimony yellow", "chamois") not fading, edges crenate or merely uneven, at times marginate with reddish brown in age.

Stipe 2.5-5 cm. long 1.5-5 mm. thick at apex, equal or the base enlarged (up to 7 mm.), and tapering upward, solid at first (interior concolorous with pileus flesh), becoming hollow, at times eccentric, often curved, surface innately fibrillose-striate, concolorous with lamellae, darkening to dingy "ochraceous buff", "cinnamon", or "dresden brown", base with white tomentum and sometimes a few white rhizoids.

Spores 4.5-7 × 2.5-4 μ, elliptical, sometimes elliptic-oblong, smooth, not amyloid, often with vinaceous droplets or contents in KOH, white in mass; basidia 16-28 × 4.5-7 μ, 2- or 4-spored, often with vinaceous droplets or granules in KOH; pileus tissue: fresh material yellowish in water mount, revived material pale vinaceous in KOH, pigment in cell contents and often punctate-encrusted, surface at times with protruding cystidioid end cells, cuticular hyphae cylindrical, 2.5-5.5 μ in diameter, tramal hyphae cylindrical to slightly inflated, 2-8 μ in diameter, clamp connections absent; gill trama subparallel, broad, hyphae cylindrical to slightly inflated, 2.5-7.5(-9) μ in diameter.

Scattered to gregarious or occasionally cespitose. On conifer logs and stumps.

Material examined: *Bigelow 10788*, near Katahdin Stream Campground, Baxter State Park, **Maine**, August 6, 1962; *7309*, *7310*, *7311*, Amherst, **Massachusetts**, August 4, 1958; *7411*, Amherst, August 9, 1958; *7515*, Amherst, August 17, 1958; *7600*, Mt. Toby, Sunderland, August 27 1958; *7739*, Mt. Toby, September 15, 1958; *7802*, Mt. Toby, September 20, 1958; *8264*, Amherst, July 25, 1959; *8956*, Wahconah Falls, Dalton, July 26, 1960; *9007*, D.A.R. State Forest, Goshen, August 2, 1960; *9234*, D.A.R. State Forest, September 1, 1960; *9624*, Pittsfield State Forest, Pittsfield, July 26, 1961; *9683*, New Salem, August 2, 1961; *11990*, near Sawyer Rock, White Mts. Nat. Forest, **New Hampshire**, July 27, 1963; *12246*, Oliverian Brook Trail, White Mts. Nat. Forest, August 13, 1963; *C. H. Peck*, North Greenbush, **New York** (type of *Agaricus rubescentifolius*, NYS), August; *C. H. Peck*, Croghan (type of *Agaricus coloreus pro parte*, NYS).

This agaric can be very confusing in the field as the

colors of the pileus and stipe vary markedly according to the age of the carpophore or its moisture content. In my field work the brown stage of the pileus seemed to be encountered much more frequently than the yellow stage.

I have not had the opportunity to study other species in this genus, but the carpophores of *C. luteoolivaceum* at least turn a rather bright vinaceous red when dilute KOH solution is applied to fresh material. In drying, specimens become a dark vinaceous color over all.

Clitocybe albimontana Bigelow, *nomen novum*

Omphalina oreades Singer, Pap. Mich. Acad. Sci., Arts & Letters **32:** 123. 1946.

Pileus (2.5-)4-10 mm. broad, convex with an incurved margin at first, expanding to broadly convex, disc rarely slightly depressed, glabrous and striate moist, disc brown, striations dark brown ("bister"), paler in between striations (near "snuff brown"), hygrophanous, fading to sordid alutaceous, fibrillose and opaque faded, fibrils often erect near margin; flesh thin, pliant, concolorous with pileus moist or faded, no odor, taste mild.

Lamellae decurrent, usually evenly and forming a collar on the stipe apex, narrow to moderately broad (± 1 mm.), distant, rarely forked, not intervenose, arched, color a pale "buffy brown", edges even.

Stipe 6-9 mm. long, 0.5-1.5 mm. thick, equal or tapering downward from a slightly enlarged apex, pruinose at first becoming glabrous, solid, rather soft, darker brown than lamellae ("buffy brown", "Saccardo's umber").

Spores 7.5-10 × 3-4 μ, shape variable: elliptical to obovate or subcylindrical in face view, sublacrymoid or lacrymoid in side view, sometimes slightly bent at either end, smooth, not amyloid; basidia 24-31 × 5.5-7 μ, 4-spored, sterigmata up to 7 μ long, basidioles somewhat irregular in shape at times; cystidia not differentiated; pileus tissue: cuticle brown in KOH, pigment finely but distinctly encrusted, hyphae cylindrical or inflated, 3-8.5 μ in diameter, trama pale brown, hyphae smooth or encrusted, cylindrical or inflated, 3-11 μ in diameter, clamp connections absent; gill trama interwoven, pale brown, hyphae smooth or encrusted, cylindrical or inflated, 1.5-7(-11) μ in diameter.

Scattered or gregarious. On moss or sandy soil in alpine zone.

Material examined: *Bigelow 11918, 11919*, Lake-of-the-Clouds Trail from peak, Mt. Washington, **New Hampshire**, July 23, 1963; *12339, 12340*, trail to Alpine Garden from peak, Mt. Washington, August 19, 1963; *R. Singer*, Mt. Washington (type of *Omphalina oreades*, F).

Plate 1332 *Hygrophorus lilacinus* (Laest.) M. Lange. × 1.

The preceding records are apparently the first of this species since Singer found it twenty years ago in the same locality. *C. albimontana* is easily overlooked because of its small size and a tendency to grow under overhanging moss where water or paths have cut down into the soil. A number of carpophores were found on both east and west sides of the mountain below the peak.

In transferring *Omphalina oreades* to *Clitocybe*, a new species epithet is necessary because of *Clitocybe oreades* Murrill.

Clitocybe asterospora (Lange) Moser apud Gams, Kleine Kryptogamen Flora II, p. 52. 1953.

Gregarious. On wet moss, in depression between rocks.

Material examined: *Bigelow 14223*, top of Mt. Mansfield, **Vermont,** September 24, 1964.

This agaric appears to be rare in North America. I know of fruitings only in Michigan and Ontario besides the specimens found on Mt. Mansfield.

Hygrophorus lilacinus (Laest.) M. Lange, Meddelelser om Grønland 148(2): 63. 1957. Plate 1332.

Plate 1333 *Hygrophorus monticola* Hesler & Smith. × 1.

Agaricus (Omphalia) lilacinus Laestadius, Lapp. Torn. p. 45, n. 156. 1860.

Hygrophorus violeïpes M. Lange, Meddelelser om Grønland 147(11): 18. 1955.

Material examined: *Bigelow 13656*, Mt. Mansfield, **Vermont**, August 29, 1964.

A small group of carpophores was found in a mossy depression near the "upper lip" on top of Mt. Mansfield. The bright luteous colors of cap and gills and the violet stipe make this species easy to recognize in the field. In microscopic characters as well as all field characters, my specimens agree exactly with Lange's (1955) description of *H. violeïipes*. Apparently Bigelow 13656 is the first record of *H. lilacinus* in North America.

In 1957, Lange placed *Omphalia luteolilacina* Favre in synonymy with *H. lilacinus*. While there is certainly a resemblance between the two species, I do not agree with Lange's treatment. As described by Favre (1955), *O. luteolilacina* lacks clamp connections, has elliptic-cylindric spores and a hispid stipe. These characters are unlike *H. lilacinus* and certainly sufficient to maintain *O. luteolilacina* as a separate taxon.

Hygrophorus monticola Hesler & Smith, North American Species of *Hygrophorus*, p. 359. 1963. Plate 1333.

Pileus 1.5-16 cm. broad, at first convex with an incurved and inrolled margin, not striate, slowly expanding to plane with a decurved margin, elevated in age, surface dry and unpolished, finely matted-fibrillose on disc under a lens, glabrous at the margin, cracked at times in age or dry weather, color dingy "cinnamon" to "vinaceous cinnamon" or "sayal brown", margin whitish at times, "russet vinaceous" over all when dry; flesh thick on disc, tapering abruptly to margin, whitish (near "cartridge buff"), firm, brittle, odor strong, sweet like that of cherries, taste mild.

Lamellae decurrent (evenly at times and forming a collar on the stipe apex), distant, thickened, broad (3-11 mm.), occasionally forked, sides venose at times, arched, color "cream buff" to "ochraceous buff", edges even.

Stipe 2-12 cm. long, apex 0.8-4.2 cm. thick, equal in smaller carpophores but tapering downward strongly in larger ones, solid (white

within), no veil, surface dry and unpolished, velvety to pubescent under a lens, appressed in age, whitish.

Spores 9-11.5(-13) × 6-7.5 μ, elliptical, smooth, not amyloid; basidia 46-68 × 5.5-8 μ, 4-spored; cystidia not differentiated; pileus tissue: cuticle pale yellowish in KOH, pigment dilute in the contents of some surface hyphae, cuticle an ixocutis, hyphae cylindrical, 2.5-4 μ in diameter, walls thin, tramal hyphae mostly cylindrical, 3-9(-14) μ in diameter, walls often slightly thickened, clamp connections present; gill trama: divergent in young carpophores but appearing more interwoven in large caps, hyphae cylindrical, 4-7.5 μ in diameter.

Gregarious to cespitose. In soil and needle beds under spruce.

Material examined: *Bigelow 13917, 13984, 14124, 14204, 14278, 14323, 14350, 14373*, Lamoille and Washington counties, **Vermont,** September and October.

In Hesler and Smith's (1963) monograph of *Hygrophorus*, *H. monticola* is described from specimens collected in Idaho and eastern Canada. The pilei measured 2-5 cm. broad, and the stipes 3-6 cm. × 3-25 mm. In view of these dimensions, the Vermont specimens are most impressive in size. The odor of cherries was very pronounced as well and could be detected without crushing the flesh, sometimes from several feet away. Of further note, and perhaps worthy of emphasis in diagnosis, was the tendency of the pileus to become more intense in color with drying.

Hygrophorus nitiosus Blytt, Norges Hymenomycetes. Videnskab Selskabets Skrifter. Math. Naturv. Kl. 1904, No. 6. 1905.

Gregarious. On soil of dirt road in hardwoods.

Material examined: *Bigelow 13132*, Stowe, Lamoille Co., **Vermont,** July 28, 1964.

Hygrophorus tahquamenonensis Smith & Hesler, Sydowia 8: 331. 1954.

Gregarious to subcespitose, on moss by stream, near hardwoods.

Material examined: *Bigelow 13242*, Bingham Falls, near Stowe, Lamoille Co., **Vermont,** August 3, 1964.

Mycena atkinsoniana A. H. Smith, North American Species of *Mycena*, p. 144. 1947.

On leaves and humus under beech.

Material examined: *Bigelow 13936*, Bingham Falls, near Stowe, Lamoille Co., **Vermont,** September 9, 1964; *14059*, near Lake Mansfield, Lamoille Co., September 14, 1964.

Paxillus curtisii Berkeley, Ann. Mag. Nat. Hist. II, **12**: 423. 1853.

On hemlock logs.

Material examined: *Bigelow 11906*, South Conway, Carroll Co., **New Hampshire**, July 22, 1963; *12093*, same locality, August 3, 1963; *12398*, *12399*, same locality, September 4, 1963.

Phaeocollybia kauffmanii (Smith) Singer, Rev. Mycol. **5**: 11. 1940.

Naucoria kauffmanii Smith, Mycologia 29: 52. 1937.

Pileus 1.3-5.5 cm. broad, obtuse-conic or convex at first with margin slightly incurved and narrowly inrolled, not striate, expanding somewhat to broadly convex with margin remaining incurved and inrolled, sometimes lobed, surface glutinous or viscid, smooth, glabrous, color watery "cinnamon" to "sayal brown", fading to "cinnamon buff", at times with a few dark reddish flecks; flesh thick, firm, whitish, odor and taste farinaceous.

Lamellae emarginate (notch small and abrupt, superficially appearing "free"), close, narrow to medium broad (2-7 mm.), forked at times, white at first then "vinaceous buff" or "pale pinkish buff", edges slightly uneven.

Stipe 4-13 cm. long, apex 5-11 mm. thick, often subventricose (up to 16 mm. thick), attenuated and radicating (about half of stipe above soil), at times twisted, usually curved below, surface innately fibrillose, moist but not viscid, solid (cortex thick and brown in section, interior firm, whitish to "pale ochraceous buff"), color watery "cinnamon buff" above, rufous stained below, especially on lower portion embedded in soil.

Spores 7.5-9 × 5.5-6 μ, ovate in face view, inequilateral in side view, with a minute apical pore but no conspicuous beak, rugulose-roughened, fulvous in KOH; basidia 23-31 × 7.5-10 μ, 4-spored, protruding beyond the hymenium at maturity; cystidia: cheilocystidia abundant, pleurocystidia rare, both basidioid to clavate in shape, sometimes rather irregular and with broad lump near apex, rarely 2-celled, often with dilute brownish contents, smooth, thin-walled; pileus tissue: surface layer a distinct gelatinous pellicle in KOH, hyaline, hyphae 1.5-2.5 μ in diameter, trama brown in KOH, pigment finely but distinctly encrusted on some hyphae in subpellicular zone, in smooth and thickened walls below, hyphae cylindrical to somewhat inflated, 4-13 μ in diameter, clamp connections absent; gill trama parallel, brownish in KOH, pigment in thickened but smooth walls, hyphae cylindrical, 3-8 μ in diameter.

Scattered or subcespitose. On soil of river bank near hemlock.

Material examined: *Bigelow 13570*, Bingham Falls, near Stowe, **Vermont**, August 20, 1964.

P. kauffmanii is well known in the Pacific northwest

although apparently not common. Hesler (1949) has reported its occurrence in Tennessee, but I have not found any other record from the east. My specimens from Vermont fit Smith's (1957a) description except in dimensions of the carpophore. Western specimens of *P. kauffmanii* are considerably larger in size.

Pleurotus elongatipes Peck, Jour. Myc. 14: 1. 1908.

Pileus 2.5-14 cm. broad, convex to broadly convex or nearly plane, margin narrowly inrolled and incurved for some time, slightly pubescent when young, sometimes with short sulcations, surface glabrous, mottled about the disc with small watery-appearing spots, white to pale avellaneous or pale buff ("cartridge buff", "light buff"); flesh usually rather thick on disc, firm, brittle, odor often spicy and fragrant when flesh crushed, taste not distinctive.

Lamellae at first adnexed or adnate, becoming sinuate or emarginate, seceding at times, moderately broad (5-11 mm.) near stipe but narrowed at margin of pileus, usually close but sometimes crowded, not forked or intervenose, white or whitish, edges uneven and brittle in age.

Stipe 3-10 cm. long, apex 4-20 mm. thick, base usually somewhat enlarged and tapering upward, sometimes ventricose, solid (interior white and soft), cavernous in age, often curved, eccentric at times, surface with a thin fibrillose coating, becoming innately fibrillose-striate, apex pruinose to pubescent at times, white or nearly so.

Spores 4-5.5 × 4-4.5 μ, globose to subglobose, smooth, not amyloid, white to slightly cream tinged in deposit; basidia 16-24 × 4-6 μ, 4-spored, carminophilous granules absent; cystidia not differentiated; pileus tissue: surface subgelatinous to gelatinous in KOH, cuticular hyphae cylindrical, 1.5-3 μ in diameter, tramal hyphae cylindrical to slightly inflated, 2.5-13 μ in diameter, clamp connections present, walls thin or slightly thickened and refractive; gill trama regular to subparallel, broad, hyphae mostly cylindrical, (1.5-)4-9(-11) μ in diameter, wall thin or slightly thickened and refractive.

Solitary or cespitose. On hardwood logs and stumps, sometimes in wounds of living maple.

Material examined: *Bigelow 8665*, North Pond, Savoy Mt. State Forest, Florida, **Massachusetts**, September 22, 1959; *9362*, Beartown State Forest, Monterey, September 27, 1960; *10809*, Katahdin Stream Campground, Baxter State Park, **Maine**, August 6, 1962; *11146*, near Norcross, Penobscot Co., August 18, 1962; *11259*, Cedar Lake, Penobscot Co., August 24, 1962; *D. E. Fischer*, Detroit, **Michigan**, October 5, 1905 (type, NYS); *Bigelow 12524*, Oliverian Brook Trail, White Mts. Nat. Forest, **New Hampshire**, September 7, 1963; *13842*, near Johnson, Lamoille Co., **Vermont**, September 2, 1964; *13937*, Bingham

Falls, near Stowe, Lamoille Co., September 9, 1964; *14048*, Stowe, September 13, 1964; *14110*, Ranch Brook Trail, Mt. Mansfield State Forest, September 16, 1964; *14116*, Monroe State Park, Washington Co., September 17, 1964.

Pleurotus elongatipes has proven to be quite common in New England. I have found it growing on birch and poplar debris as well as on dead or living maple. A description based upon specimens from Mt. Rainer, Washington, has been published by A. H. Smith (1957b).

This species is a *Pleurotus* in the traditional sense of the genus, but the globose spores exclude it from modern interpretations. According to Singer's (1962) classification, the closest affinities may be with *Hypsizygus*, but some emendation of this genus would be necessary to admit *P. elongatipes*.

ASCOMYCETES

Keissleriella caudata (Müller) Corbaz, Phytopath. Zeitschr. **28**: 411. 1957. Figure 8.

Material examined: *Barr 2896*, on cultivated rose stems, Conway, **Massachusetts,** May 7, 1961.

K. caudata was described from *Triticum* stalks in Europe. The collection on rose stems agrees with the description of the species, although the ascospores are slightly longer, 15.5-17.5 × 3.5-4.5 μ rather than 10-13 × 4-4.5 μ. This species differs from *K. cladophila* (Niessl) Corbaz by smaller, thinner-walled ascostromata, lack of a clypeus, and narrower ascospores. *Keissleriella* is included in the Pleosporaceae.

Lasiosphaeria chrysentera Carroll & Munk, Mycologia **56**: 83. 1964.

Material examined: *Barr 3338*, Abol Field, near Baxter State Park, **Maine,** July 6, 1962.

The species, described from Costa Rica, is closely related to *L. ovina* (Pers. ex Fr.) Ces. & de Not. *L. chrysentera* differs in golden-yellow pigmentation of the hymenium, bright yellow globule at apex of ascus, and yellowish ascospores. One additional collection has been examined from

Idaho, A. W. Slipp, U.I.F.P. Herb. 3834, on decorticated *Alnus tenuifolia*, 1943. *Lasiosphaeria* is a member of the Sordariaceae.

Leiosphaerella falcata Barr, *sp. nov.*, figures 1-4.

Perithecia 180-300 μ diametro, 130-250 μ alta, immersa, gregaria, ostiola eccentrica vel lateralia, 60-120 μ diametro, 70-150 μ alta, periphysata; peridium 13-16.5 μ crassum, brunneum, hyphis brunneis vestita. Asci 55-100 × 11-14.5 μ, elliptica, unitunicata, ad apicem poro amyloideo, paraphysati. Ascosporae 46-86 × 3-5 μ, fusiformae vel falcatae, hyalinae, uniseptatae, fasciculatae in ascis.

Specimen typicum in caulis *Aceris pensylvanicum* L., a **M.E. Barr** lectus, n. **3460**, prope "Katahdin Stream Campground, Baxter State Park, Maine, July 23, 1962", in herbario Univ. Mass. depositum.

Perithecia 180-300 μ in diameter, 130-250 μ high, depressed globose, immersed beneath epidermis and raising it slightly, thickly scattered, ostiole eccentric to lateral, 60-120 μ in diameter, 70-150 μ high, piercing the covering layer of substrate, canal periphysate, perithecial wall 13-16.5 μ wide, of polygonal, brown, compressed layers of cells, inner layers hyaline, with brown hyphae surrounding perithecium and penetrating substrate tissues. Asci 55-100 × 11-14.5 μ, elliptical, apex rounded or truncate, narrowed abruptly below spores into rounded base, wall single, thickened above with refractive pore, amyloid in Melzer's, paraphyses deliquescent and forming an amorphous mass around asci. Ascospores 46-86 × 3-5 μ, greenish hyaline, fusiform to falcate, tapered to pointed ends, 1-septate in or near the middle, not constricted at the septum, wall thin, smooth, contents homogeneous or globular, in two overlapping fascicles in the ascus.

In small dead branches of *Acer pensylvanicum* and *A. spicatum*.

Material examined: *Barr 3267*, Norcross, Penobscot Co., **Maine**, June 30, 1962; *3460* (*type*), Katahdin Stream Campground, Baxter State Park, July 23, 1962; *3644*, Norcross, August 18, 1962; *3995A*, Stony Brook Trail, near Gorham, **New Hampshire**, July 26, 1963; *2098*, Lake Munroe, Mt. Tremblant Park, **Quebec**, July 24, 1957; *4179*, Underhill Camp Area, Mt. Mansfield State Forest, **Vermont**, June 30, 1964; *4334*, Mt. Elmore State Park, July 16, 1964.

L. falcata is closely related to *L. praeclara* (Rehm) von Höhnel, the type of the genus, and *L. phoenicis* (Chona & Munjal) Müller & Ahmad in spore shape. The other members of the genus have shorter, relatively broad spores. The eccentric to lateral position of the beak of *L. falcata* and the longer spores distinguish it from the other species. This fungus shows affinities to members of *Ceriospora* but differs by lacking spore appendages and by simpler apical appara-

Legend for Figures 1-8

Figs. 1-4. *Leiosphaerella falcata Barr, sp. nov.:* 1, perithecia beneath bark, 2, ascus, 3, ascus showing amyloid apical ring, 4, ascospores. Figs. 5-7. *Mycosphaerella linnaeae* Barr, *sp. nov.:* 5, ascostroma, 6, ascus, 7, ascospores. Fig. 8. *Keissleriella caudata* (Müller) Corbaz: ascospores. Figs. 1, 5, × 80; figs. 2-4, 6-8, × 750.

tus of the ascus. In the classification of Müller & von Arx (1962), *Leiosphaerella* is considered to be a member of the Amphisphaeriaceae.

Mycosphaerella linnaeae Barr, *sp. nov.*, figures 5-7.

Ascostromata 80-100 μ diametro, 72-100 μ alta, immersa, gregaria, epiphylla; peridium 11-14.5 μ crassum, brunneum, hyphis brunneis. Asci 36-45 × 7.5-9 μ, oblonga, bitunicata, aparaphysata. Ascosporae 16.5-21 × 2-3 μ, fusiformae, hyalinae, uniseptatae, in duobus fasciculatae in ascis.

Specimen typicum in folia *Linnaeae borealis* L. var. *americanae* (Forbes) Rehd., a **M.E. Barr** lectus, n. **3831,** prope "Millbrook Trail, Jefferson, White Mts. Nat. Forest, New Hampshire, July 6, 1963", in herbario Univ. Mass. depositum.

Ascostromata 80-100 μ in diameter, 72-110 μ high, globose, slightly depressed or conical, immersed in leaf tissue, with broad blunt apex

erumpent through upper epidermis, scattered thickly and evenly over most of leaf, wall thin, 11-14.5 μ wide, two to three layers of dark brown, polygonal cells, compressed hyaline cell layers toward interior, brown hyphae copious in leaf tissues. Asci 36-45 $\times$ 7.5-9 μ, oblong, apex rounded, base foot-like, wall double, thickened above, numerous in a fascicle, aparaphysate. Ascospores 16.5-21 $\times$ 2-3 μ, greenish hyaline, fusiform, ends pointed, straight to curved, one-septate in middle, not constricted at septum, wall thin and smooth, contents guttulate or with two globules in each cell, overlapping in two fascicles in the ascus.

On overwintered leaves of *Linnaea borealis* var. *americana*.

Material examined: *Barr 3831* (*type*), Millbrook Trail, Jefferson, White Mts. Nat. Forest, **New Hampshire**, July 6, 1963; *1906*, woods near chalet, Mt. Albert, Gaspe Prov. Park, **Quebec**, July 6, 1957.

A species of *Cercospora* is intimately associated with *M. linnaeae*, and I suggest that it may form part of the life cycle of this species. This *Cercospora* has conidiophores short, brown, septate, erumpent through upper leaf epidermis, often arising from apex of young ascostromata; conidia 24-54 $\times$ 2 μ, greenish hyaline, cylindrical, ends rounded, several-septate, contents guttulate. I have found no records of *Cercospora* on *Linnaea* (Chupp, 1953).

At least twenty-four species of *Mycosphaerella* have been described on members of the Caprifoliaceae, but only two were reported on *Linnaea*. *M. minor* (Karst.) Johans. has smaller ascostromata, broadly saccate asci and clavate ascospores 11-12 $\times$ 4 μ. No measurements have been given for *Sphaerella leightonii* (Berk. & Br.) Cooke, but ascospore shape and septation is quite different from that of *M. linnaeae*. As described in the literature, the other species of *Mycosphaerella* on members of the Caprifoliaceae do not appear similar to Barr 3831 and 1906. *M. crepidophora* (Mont.) Rehm and *M. ebulina* Petrak have elongate ascospores and seem most closely related to *M. linnaeae*. *M. crepidophora* develops in spots in living leaves of *Viburnum;* the ascospores are cylindrical or oblong and are somewhat broader than those of *M. linnaeae*. *M. ebulina* occurs on dead leaves of *Sambucus*. The ascostromata are densely gregarious to form angular black spots, asci are larger, and ascospores broader than in *M. linnaeae*. The broad apex of

the ascostromata and elongate, narrow fusoid ascospores are distinguishing characters of *M. linnaeae*.

Plagiostigme petrakii Müller, Sydowia **18**: 90. 1965.

Plagiophiale petrakii (Müller) Petrak, Sydowia **18**: 387, 1965.

Material examined: *Barr 4094*, on overwintered leaves of *Polygonum viviparum*, Alpine Gardens, Mt. Washington, **New Hampshire**, August 19, 1963.

This rare and distinctive fungus has been illustrated and described recently by Müller (1965), who made several collections of it on *Polygonum viviparum* from the Swiss and Italian Alps. Petrak (1955) was first to collect *P. petrakii*, but thought it to be identical with *Sphaerella eucarpa* Karst. At that time he erected the genus *Plagiophiale* for the species. However, *Sphaerella eucarpa* Karst. is a species of *Wettsteinina* (Barr 1959, Müller and von Arx 1962), and therefore *Plagiophiale* Petrak is a nomenclatural synonym of *Wettsteinina*. Müller (1965) has discussed in detail the generic position of the species on *Polygonum*. The North American material appears to be identical in all respects with that described from Europe.

Plectosphaera salicis (Fckl.) v. Arx & Müller, Beitr. Kryptogamenfl. Schweiz **11**(1): 204. 1954.

Material examined: *Barr 3928*, *Salix* twigs, South Conway, **New Hampshire**, July 18, 1963.

This appears to be the first record of *P. salicis* in North America. According to the literature, this pyrenomycete has been found previously only in Europe. My collection agrees with the description and figure in von Arx and Müller (1954).

Podosphaera clandestina (Wallr. ex Fr.) Lév. Ann. Sci. Nat. Bot. III, 15: 36. 1851, var. **clandestina**

Material examined: *Barr 4578*, *Vaccinium angustifolium*, top of Mt. Mansfield, **Vermont**, August 28, 1964; *4583*, *V. uliginosum*, data as above; *4585*, *Ledum groenlandicum*, data as above.

This minute powdery mildew has been recorded only rarely on members of the Ericaceae, chiefly species of *Vaccinium*, and never, as far as I could determine, on *Ledum*.

The specimens are in close accord with the description of *P. oxyacanthae* var. *oxyacanthae* in Salmon (1900).

Thaxteria fusca (Fckl.) Booth, The Naturalist, London, p. 90. 1958.

Sphaeria phaeostromoides Peck, N. Y. State Mus. Rep. 28: 77. 1876.

Chaetosphaeria phaeostromoides (Peck) Sacc. Syll. Fung. **2**: 93. 1883.

Chaetosphaeria phaeostroma var. *phaeostromoides* (Peck) Ell. & Everh. North Amer. Pyreno., p. 160. 1892.

Material examined: *Barr 4041*, on fallen beech, near Sawyer Rock Picnic Area, White Mts. Nat. Forest, **New Hampshire**, August 10, 1963; *C. H. Peck*, on decorticated *Acer*, North Greenbush, **New York**, September 1874 (type of *Sphaeria phaeostromoides* Peck, NYS).

The collections cited above agree with Booth's (1958) description and figures of *T. fusca*, and bear both conidial and perithecial stages. Ellis and Everhart (1892) cited a collection from Missouri, but otherwise the fungus appears to be collected rarely. The genus *Thaxteria* is a member of the Coronophoraceae.

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NOTES ON RAFINESQUE'S SPECIES OF LECHEA (CISTACEAE)

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It was suggested in an earlier paper (Wilbur & Daoud, 1961) that some of the twenty species of *Lechea* published by Rafinesque (1836) would eventually prove identifiable and that their names would replace binomials then current. This may have seemed an unwarranted assumption since three careful students of this technical genus had diligently studied Rafinesque's monograph and concluded that the descriptions were not adequate to identify the species intended with any degree of confidence. Leggett (1878) republished much of Rafinesque's monograph and suggested the possible identity of several of the taxa. Britton (1894) indicated that he had worked closely with Leggett in attempting to unravel the problems of the genus and together they had "pored over Rafinesque's monograph". They finally concluded that "unless type specimens could be found, there could be no certainty" in applying any of the names. Hodgdon (1938:30) suggested that Rafinesque's "perplexing" monograph left the genus in a "deplorable state" and claimed to have been able to identify only four of Rafinesque's twenty new binomials.

I believe however that the majority of Rafinesque's species of *Lechea* can be identified with considerable certainty even in the absence of types by comparing his descriptions with the species known to occur in the areas mentioned in the original publication. The results of this analysis are presented in the following paragraphs presented in the same order as Rafinesque's monograph (1836) and followed chronologically by his other papers dealing with the genus. Unfortunately, for stability's sake, three of Rafinesque's

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binomials must replace those of species long known by later names.

1. *Lechea pulchella* Raf., New Fl. N. Am. 1: 91. 1836.

Rafinesque definitely mentioned *L. pulchella* only from the pine barrens of New Jersey although suggesting that its range probably extended to the south. The species was described as being "quite smooth" and, as a member of Rafinesque's subgenus *Menandra*, it can be assumed that its outer sepals were noticeably shorter than the inner, a feature which helps to narrow the list of possible species to four. Of the seven species of *Lechea* known from New Jersey, only *L. maritima* Legg., *L. intermedia* Legg. ex Britt., *L. leggettii* Britt. & Holl. and usually *L. racemulosa* Michx. have external sepals exceeded by the inner. *Lechea maritima* may be safely discounted as a suspect as it could never be described as "quite smooth" even upon the most superficial observation and its cauline leaves tend to be whorled and not "scattered." Rafinesque described the leaves of *L. pulchella* as "scattered long linear" and its capsules as "obovate." These features make it possible to exclude *L. racemulosa* from consideration for its principal or lower and median cauline leaves are commonly opposite or even whorled and elliptic to lanceolate or even oblanceolate and perhaps more significantly it possesses a barrel-shaped or cylindrical capsule. Rafinesque's subgenus *Menandra* was described as having seeds 1-3 in number which agrees with the number characteristic of *L. leggettii* but not with the 4-6 seeds characteristic of *L. intermedia*. Furthermore *L. leggettii* is known from the New Jersey pine barrens while *L. intermedia* apparently is not. Leggett (1878: 247) questioningly suggested that Rafinesque's *L. pulchella* was the same as the species then called "*L. minor* Lam." which is what has recently been called *L. leggettii*. Leggett (1878: 250) twice encountered in the pine barrens "an abnormally smooth Lechea" which pretty well matched Rafinesque's description. These smooth plants were what is now called *L. leggettii*. Accompanying the original publica-

tion of *L. leggettii* the name var. *pulchella* was appended with *L. pulchella* Raf. questioningly listed in synonymy indicating Britton's earlier similar suspicions.

The evidence seems sufficiently convincing that I do not hesitate to take up Rafinesque's binomial for the species most recently known as *L. leggettii.* New combinations for the varieties recognized by Hodgdon are not made for I am not convinced that these tendencies represent biological varieties or subspecies. Rafinesque (1836: 91) named three varieties based upon the luxuriousness of the plants and the shape of the inflorescence. These varieties were var. *minor* Raf., var. *elegans* Raf. and var. *pyramidalis* Raf.

2. *Lechea cinerea* Raf., New Fl. N. Am. 1: 91. 1836.

Leggett (1878: 250) felt that Rafinesque's description was a "pretty correct" one for the species he had previously distributed as *L. torreyi.* He noted however that there were 3-seeded and 6-seeded forms of the species and hoped that his proposed *L. torreyi* would prove distinct. Hodgdon (1938: 106-107) discussed Rafinesque's description and concluded that it was apparently based upon two or more species. The original description includes nothing that would suggest to me that Rafinesque had both *L. torreyi* and *L. patula* as seemed likely to Hodgdon but the point is academic. Rafinesque parenthetically placed *L. thymifolia* Michx. in synonymy of his own *L. cinerea* and again in closing mentioned the possibility that it was "the real *thymifolia.*" Rafinesque's binomial hence is illegitimate as nomenclaturally superfluous when published according to the International Code (Article 63). The fact that Michaux's binomial is actually a synonym of *L. minor* L. does not alter the fact that Rafinesque first placed Michaux's name unequivocally in the synonymy of his own species.

3. *Lechea ternifolia* Raf., New Fl. N. Am. 1: 91. 1836.

Rafinesque stated that his *L. ternifolia* from "Virginia, New Jersey and probably elsewhere" "must be the real

L. racemulosa" of Michaux. Both Rafinesque and Michaux quote the same Gronovian polynomial. And Rafinesque's description itself ("stem . . . adpressed pubescent, leaves and branches mostly ternate cuneate acute ciliate nearly smooth; racemes paniculate lax nearly naked, peduncles elongate, capsules oblong") indicates that *Lechea ternifolia* Raf. can be placed with confidence in the synonymy of *L. racemulosa* Michx. Leggett (1878: 247) with some question and Grosser (1894: 135) unequivocally placed Rafinesque's binomial in the synonymy of Michaux's species while Hodgdon (1938) did not mention it.

4. *Lechea furfuracea* Raf., New Fl. N. Am. 1: 92. 1836.

Leggett stated (1878: 250) that he had "never seen anything to which this description would apply." No one else has been able to suggest what species Rafinesque had from "Kentucky and Illinois" with "mealy pubescence and globose capsules," very short external calyx-lobes, and rounded internal and "narrow linear scattered nearly obtuse" leaves. According to the most authoritative listings of *Lechea* in Illinois (Jones & Fuller, 1955) and in Kentucky (Braun, 1943) there are in fact no species known to be common to both states possessing external calyx-lobes shorter than the inner. *Lechea racemulosa* Michx. is the only species from Kentucky whose calyx approximates Rafinesque's description and its capsule and foliage would definitely exclude it as a possible synonym of *L. furfuracea*. The three species from Illinois with appreciably shorter external than inner sepals are *L. stricta* Legg., *L. intermedia* Legg. and *L. leggettii* Britt. & Holl. Rafinesque's description is not detailed enough to permit me to determine which species he had.

5. *Lechea laxiflora* Raf., New Fl. N. Am. 1: 92. 1836.

Rafinesque's description seems certainly to apply to the species long known as *L. leggettii*. Leggett (1878: 247) thought it probably was "*L. minor* Lam." which was the name by which *L. leggettii* was known in the later nine-

teenth century. Rafinesque found this species in "the New Jersey Pine Woods with *L. pulchella*" to which he felt it closely related. The more significant points in Rafinesque's description are as follows: "smooth . . . branches lax, leaves scattered linear cuneate acuminate ciliate; racemes scattered lax, flowers remote naked, pedicels elongate, calix and capsules ovate." I recommend (see No. 1 above) that *L. pulchella* be adopted as the earliest name for this species with *L. laxiflora* placed in its synonymy. Rafinesque also distinguished a var. *brevifolia* with reddish rather than greenish flowers and shorter, more cuneate, less ciliate leaves. Rafinesque indicated that the principal difference between this species and his *L. pulchella* was chiefly in the leaves which in *L. pulchella* were "scattered long linear acute" and by inference eciliate in contrast to the acuminate, ciliate leaves of *L. laxiflora.*

6. *Lechea tenuifolia* Michx., Fl. Bor.-Am. 1: 77. 1803.

Rafinesque's account is largely a translation of Michaux's original description. It is placed by Rafinesque with those species with short external sepals while the species to which we apply the name has external calyx lobes equaling or more commonly longer than the inner. Rafinesque cited no localities other than the Santee River which had been cited in Michaeux's original account so it is not certain whether Rafinesque had actually seen specimens of this species in spite of his statement that he had "specimens of all of the described species." Perhaps Rafinesque placed it with the species of *Lechea* with short calyx-lobes since Elliott (Sk. Bot. S. C. & Ga. 1: 185. 1816.) implied that this species had no external calyx and this statement was included by Rafinesque. Elliott in turn had been misled by Walter (Fl. Car. 83. 1788) who reported there was no outer calyx in his *L. juncifolia,* a species which has never been satisfactorily identified.

6[a]. *Lechea verna* Raf., New Fl. N. Am. 1: 92. 1836.
This binomial was published as a substitute name ("6. L.

tenuifolia Mx. Elliot or L. verna Raf. L. juncifolia Walter.") and is therefore illegitimate.

7. *Lechea recurvata* Raf. New Fl. N. Am. 1: 93. 1836.

This species was placed by Rafinesque in his subgenus *Menandra* possessing short external calyx-lobes. It was said to possess globose capsules and to occur "in Carolina and Virginia." I believe that this is the species referred to in the most recent monographs of Britton (1894) and Hodgdon (1938) as *L. leggettii.* If my interpretations of Rafinesque's species are correct, *Lechea pulchella, L. laxiflora* and *L. recurvata* are all prior names for the species now called *L. leggettii.* There are only two Lecheas common to both Virginia and "Carolina" possessing external calyx-lobes shorter than the inner; these two are *L. racemulosa* and *L. leggettii.* The described globose capsules of *L. recurvata* would seem to exclude *L. racemulosa* as a possibility although, judging by the following features mentioned "branches opposite and ternate, leaves broad oblong acute at both ends ciliate," it might seem a better match for Rafinesque's description than *L. leggettii.*

8. *Lechea mucronata* Raf., Précis des Découvertes Somiol. 37. 1814.

To my knowledge only House (New York St. Mus. Bull. 254: 497. 1924) has taken up this name although Robinson (Syn. Fl. N. Am. 1: 192. 1895) and Grosser (1903: 135) both placed it unquestioningly in the synonymy of *L. major* in the sense of Michaux but not of Linnaeus. *Lechea major* sensu Michaux, Robinson and Grosser is synonymous with *L. villosa* Ell. Hodgdon, the most recent monographer of the genus, concluded that there was not enough evidence presented in Rafinesque's original description to warrant the displacement of Elliott's *L. villosa,* a "well-characterized and clearly typified name." Rafinesque's original description is presented below in full so that others may form their own conclusions independent of my own interpretation. I am

indebted to Mrs. Lazella Schwarten, Librarian of the Harvard Herbaria, for making a copy of it available.

120. *Lechea mucronata.* Poilue, tige droite et simple, feuilles oblongues-cunéiformes mucronées, fleurs en grappe composée, bractéolées, bractées oblongues aigues. *Dans les bois du N. Jersey.*

Hodgdon stated (1938: 56) that the "only possible diagnostic features of Rafinesque's description are "feuilles oblongues-cunéiformes mucronées, fleur en grappe composée." He concluded that the statement concerning the arrangement of the flowers "might apply to most members of the genus" and that the described leaf shape would apply "equally well to *L. minor* as to *L. villosa.*" The description's most definitive word in my opinion is "poilue," and in addition the habitat and geographical location certainly considerably narrow the number of possibilities.

"Poilue" meaning "shaggy, hairy or pilose" best describes the species recently called *L. villosa.* The features mentioned in the brief description single out the species long incorrectly known as *L. major* and more recently known as *L. villosa.* There are seven species of *Lechea* known from New Jersey: *L. minor, L. tenuifolia, L. racemulosa, L. maritima, L. leggettii, L. intermedia* and *L. villosa.* Of these seven the last mentioned alone seems indicated by Rafinesque's description of 1814. *Lechea maritima, L. leggettii* and *L. intermedia* all possess external sepals conspicuously shorter than the internal which would exclude them from consideration. Of the seven species of *Lechea* mentioned above found in New Jersey the term "poilue" would seem to me to exclude all but *L. villosa* and perhaps *L. maritima.* The description of the leaves, although not definitive, would seem to exclude *L. maritima* but include *L. villosa* whose leaves are often mucronate. It is true that the leaves of *L. minor* sometimes would fit Rafinesque's description as indicated by Hodgdon but certainly "poilue" would scarcely be used to describe the subappressed pubescence of that species.

Rafinesque (1836: 93) more fully described his *L. mucro-*

nata indicating it to be the same as the *L. villosa* of Elliott from whom he had received specimens. Included are statements puzzling even to a casual student of the group (e.g. "capsules ovate villose") but sufficient, I believe, to convince one that Rafinesque was indeed describing, although perhaps poorly, the species called *L. villosa* by Elliott. In passing it may be noted that the capsules of all species of *Lechea* are glabrous. There actually seems to be nothing other than prejudice why we should not take up Rafinesque's name for this species since it has two years priority over Elliott's *L. villosa*. Rafinesque (1836: 93) briefly described three varieties all of which came from the extensive area of Hodgdon's var. *typica*. The three varieties were var. *simplex*, var. *ramosa* and var. *sessiliflora*. New combinations have not been made for Hodgdon's var. *macrotheca* ranging from central Nebraska south into Texas or his var. *schaffneri* from northeastern Mexico since I have not seen enough material to form an opinion as to the merits of these proposed taxa.

9. *Lechea heterophylla* Raf., New Fl. N. Am. 1: 93. 1836.

Rafinesque described this species from Kentucky and Illinois as having an appressed pubescent stem and acute, carinate inner sepals about equaling the external. Neither Leggett (1878: 248) nor Grosser (1903: 140) would hazard a guess as to what it might be. The three species common to Kentucky and Illinois possessing external sepals at least occasionally equaling the inner are *Lechea villosa* Ell., *L. tenuifolia* Michx. and *L. minor* L. The shaggy pubescence of the stem of *L. villosa* would exclude it from further consideration. The leaves were described as "commonly ternate, lower obovate, subsessile, upper cuneate and linear petiolate acute smooth." I believe this a better approximation of the greater variation shown between the lower and upper leaves of *L. minor* than the comparatively uniform condition exhibited by *L. tenuifolia*. The acute inner sepals on the other hand are a better fit for the "subacute" condi-

tion of *L. tenuifolia* than the "obtuse" inner sepals of *L. minor*. I suspect Rafinesque was describing *L. minor* since the conspicuous difference in the foliage was less subject to error by Rafinesque than the shape of the apex of the inner sepals. Rafinesque placed "L. minor Smith" in the synonymy of his *L. heterophylla* but his description would exclude the villous species that was apparently considered *L. minor* by J. E. Smith. Britton (1895: 248) has demonstrated that Smith's *L. minor* was the species which Elliott called *L. villosa*. Rafinesque published the following three varieties of this species: var. *major* Raf., *op. cit.* 94. 1836, var. *minor* Raf., *l.c.* and var. *parviflora* Raf., *l.c.* and only the last of these was even briefly described.

10. *Lechea glomerata* Raf., New Fl. N. Am. 1: 94. 1836.

Rafinesque's description of this species from the "Aplachian mts." strongly points to *L. mucronata* Raf. *(= L. villosa)* except for his characterization of it as "smooth." The carinate sepals, short pedicellate, glomerate flowers, linear external sepals about equaling the internal, the trigonous calyx surrounding the subglobose capsule and the mucronate, petiolate leaves are all indicative of *L. villosa* but that species is apparently always densely villous to spreading pilose. Leggett (1878), Grosser (1903) and Hodgdon (1938) have all found it impossible to identify Rafinesque's description and I claim no greater success.

11. *Lechea corymbosa* Raf., New Fl. N. Am. 1: 94. 1836.

The description of this species from the "Alleghany" Mountains, belonging to Rafinesque's subgenus *Lechea*, a group characterized by the external and internal sepals equaling one another, is most suggestive of *L. villosa* Ell., a later synonym of *L. mucronata* Raf. (see No. 8 above). The original description of *L. corybosa* ("stem . . . pilose . . . , leaves petiolate broad oblong nearly obtuse, . . . flowers corymbose, pedicels equal to flowers, sepals round concave, ext. linear, capsules globose . . . 6 to 12 inches high

. . . capsules large with 3 to 6 seeds . . . ") is not especially definitive but I believe it is most suggestive of *L. mucronata* of the species occurring in the Alleghenies.

12. *Lechea surculosa* Raf., New Fl. N. Am. 1: 94. 1836.

Leggett (1878: 248) questioningly suggested that this description might be *Lechea minor* [in the sense of] Lam. which is the species most recently called *L. leggettii* Britt. & Hollick. This seems an unlikely identification since *L. leggettii* is characterized by its external sepals being pronouncedly shorter than the inner while *L. surculosa*, as a member of Rafinesque's subgenus *Lechea*, would be expected to have the inner and outer sepals of approximately equal length. It is certainly true that one can not place the species of *Lechea* into three groups depending on whether the external sepals are shorter, equaling, or longer than the internal since there is too much variation in the relative length of the sepals in several species but the external sepals of *L. leggettii* are always clearly appreciably shorter than the inner. Rafinesque's species was described as possessing "acute" inner sepals while those of *L. leggettii* are clearly obtuse. There are other discrepancies, but the two mentioned are sufficient to discount completely Leggett's suggestion.

Rafinesque knew this plant from "Pennsylvania on dry hills" and indicated it was the *L. minor* of some authors. I believe the description of *L. surculosa* best matches the characteristics of *L. racemulosa*, a species whose external sepals range from obviously shorter than the inner sepals to equaling them. The inner sepals of *L. racemulosa*, according to Hodgdon's description, vary from "subacute to obtuse" while Rafinesque described those of *L. surculosa* as "acute." The capsule of *L. racemulosa* was described in Hodgdon's monograph as "slenderly ellipsoid to slenderly ovoid" while Rafinesque said those of *L. surculosa* were "ovate." Rafinesque described the sterile stems of *L. surculosa* as "pilose with leaves ternate ovatoblong acute ciliate"

which is a reasonably close approximation of Hodgdon's description of the basal shoot of *L. racemulosa:* "basal leaves frequently verticillate, . . . oblong-ovate to elliptic-lanceolate, acute to slightly mucronulate . . . prominately spreading-pilose to villous on the margins." The other species of *Lechea* from Pennsylvania with external lobes approximately equaling the inner at least occasionally *(L. villosa, L. tenuifolia* and *L. minor)* have characters which compare unfavorably with those delineated by Rafinesque. The "smooth" branches and "linear" leaves of Rafinesque's *L. surculosa* are sufficient to discount it as a possible synonym of *L. villosa (= L. mucronata).* The basal leaves of *L. tenuifolia* were described by Hodgdon (1938: 87) as "narrowly lanceolate or oblanceolate to linear" which certainly implies a much narrower leaf than does Rafinesque's description and the cauline leaves of *L. tenuifolia* are described by Hodgdon as "scattered" while Rafinesque described those of *L. surculosa* as "opposite and alternate." I believe then that *L. surculosa* Raf. is an ecologically modified form of *L. racemulosa* Michx. and that it should be placed in its synonymy.

This binomial first appeared three years earlier in Rafinesque's Herb. Raf. 68. 1833 but without description.

13. *Lechea revoluta* Raf., New Fl. N. Am. 1: 94. 1836.

Rafinesque stated that this species is the *Lechea* "minor of Lin. not of Smith nor other Authors" and that the "description is taken from Linnaeus altogether, and agrees very well with some specimens [that Rafinesque had] from the Alleghenies of Pennsylvania." Nomenclaturally the binomial is a synonym of *Lechea minor* L. Rafinesque provided a new name since J. E. Smith had indicated that Linnaeus had confounded several species within his *L. minor.*

14. *Lechea virgata* Raf., New Fl. N. Am. 1: 95. 1836.

This Alleghenian species was described as possessing

pubescent stems, opposite, whorled or even scattered, petiolate, linear, cuneate, ciliate, acuminate leaves with acute, carinate inner sepals, pedicels equaling the flower-length and ovate capsules. As a member of subgenus *Lechea*, it can be safely assumed that its external sepals equaled the inner. There are four species within the area of the Allegheny Mountains whose external sepals may commonly or occasionally equal the internal ones. These four species are *Lechea minor* L., *L. racemulosa* Michx., *L. tenuifolia* Michx. and what has been most recently referred as *L. villosa* Ell. The description is an unusually full one for Rafinesque and the above mentioned characters seems best to describe *L. tenuifolia* Michx. of the four species listed above from the Alleghenies whose external sepals commonly or occasionally equal the inner. The linear leaves, which are the only type mentioned for *L. virgata*, are sufficient to exclude *L. villosa* and *L. minor* from further consideration. The inner sepals of *L. racemulosa* are non-carinate while those of *L. virgata* were described as carinate. Two varieties were appended to this species with brief description: var. *breviflora* and var. *bracteata*.

15. *Lechea floridana* Raf., New Fl. N. Am. 1: 95. 1836.

There are eight species of *Lechea* known from Florida (Hodgdon, 1938; Wilbur & Daoud, 1961). Five of these (*L. deckertii* Small, *L. leggettii* Britt. & Holl., a later synonym of *L. pulchella* Raf. as is pointed out in no. 1 above, *L. torreyi* Legg. ex Britt., *L. divaricata* Shuttlew. ex Britt. and *L. cernua* Small) possess external sepals conspicuously shorter than the internal. The three others (*L. villosa* Ell., a later synonym of *L. mucronata* Raf. as is discussed in no. 8 above, *L. minor* L. and *L. patula* Legg.) all possess external sepals conspicuously shorter than the internal, as was described by Rafinesque for his *L. floridana*. None of these three species is "smooth" as mentioned by Rafinesque but certainly the copious, spreading villosity of *L. mucronata* (= *L. villosa*) together with its oblanceolate leaves excludes it from consideration. The appressed pubescence of

L. patula and *L. minor* could easily have been overlooked, especially if the specimens were aged, by an observer as hasty and superficial as Rafinesque often gives evidence as having been. The leaves of *L. floridana* were said to be "scattered, minute linear" which is more suggestive of *L. patula* than of *L. minor*. The external calyx of *L. floridana* was implied to equal the inner which is sometimes true of both *L. patula* and *L. minor*. The external sepals of *L. patula* most frequently are a little shorter than the inner but range up to slightly longer while those of *L. minor* rarely are as short as the inner and most frequently are conspicuously longer. The capsules of *L. floridana* were said to be ovate which is not a very apt description for the capsule of either species but, interpreted as "ovoid," not impossibly bad for either. I suspect this to be a form of *L. patula* Leggett but due to the discrepancies mentioned would not feel its identity completely certain.

16. *Lechea secundiflora* Raf., New Fl. N. Am. 1: 95. 1836.

This species came from "the glades of West Kentucky" making it impossible that its binomial could ever displace that of any of the four species definitely known from that state since each has an older name. The known species are *L. villosa* Ell., a later synonym of *L. mucronata* Raf., *L. minor* L., *L. tenuifolia* Michx. and *L. racemulosa* Michx. Rafinesque's description fits none well and there are mentioned features that would exclude each of the geographical possibilities. Grosser (1903: 135) placed Rafinesque's name in the synonymy of *L. minor* but his description of "leaves scattered, lax narrow linear, . . . flowers remote secund" would, as pointed out by Hodgdon (1938: 60), make that an unlikely choice. Hodgdon (1938: 88) placed Rafinesque's binomial in the synonymy of *L. tenuifolia* Michx. although the description of the capsules as "oblong" and the inner calyx as "lanceolate" causes considerable doubt as does Rafinesque's description of the plant as "smooth." I am unable to identify the binomial and believe the mentioned discrepancies are of such magnitude as to prevent one from

assigning it with confidence to the synonymy of any species known from Kentucky.

17. *Lechea pauciflora* Raf., New Fl. N. Am. 1: 96. 1836.

The identity of the plants described by Rafinesque under this binomial from "Near the Sea Shore in Long Island and New Jersey" was questioningly suggested by Leggett (1878: 250) to be *L. thymifolia* in the sense of Pursh which is *L. maritima* Legg., a species whose external sepals are much shorter than the heavily appressed-pilose internal calyx. Rafinesque placed *L. pauciflora* in his subgenus *Eudiexa*, characterized by outer sepals exceeding the inner, and in the diagnosis of the species specifically stated "sepals smooth, external a little longer." Grosser (1903: 135) assigned Rafinesque's binomial to the synonomy of *L. minor* L., a disposition to which Hodgdon (1938: 60) objected, feeling the described 3-inch specimens to be an "ecological variant of some other species" whose identity was undecipherable because of the incompleteness of the original publication. The only two species apparently known from both Long Island and New Jersey with outer sepals longer than the inner and "adpressed pubescent" stems are *L. tenuifolia* Michx. and *L. minor* L. Rafinesque described the capsules of his *L. pauciflora* as "globose" which among other features mentioned in the description would eliminate *L. minor*. The leaves of Rafinesque's species were described as "rather obtuse" which together with the "smooth" calyx makes it difficult to place this name in the synonymy of *L. tenuifolia* with which the description agrees in most other respects. Therefore I am unable to suggest the identity of this binomial.

18. *Lechea brevifolia* Raf., New Fl. N. Am. 1: 96. 1836.

Leggett (1879: 249) was "quite at a loss" as to what species Rafinesque's description might apply while Grosser (1903: 135) placed the binomial in the synonymy of *L. minor* L. without discussion. Hodgdon (1938: 60), while

admitting that much of Rafinesque's description applied to *L. minor*, felt that the diagnosis of "flowers secund, pedicels equal" indicated confusion on the author's part. Hodgdon's objection on these grounds are difficult to understand for the flowers and fruit are sometimes secund as his own description of *L. minor* L. admits (p. 59 "fruit mostly clustered, at times scattered or even secund") and the 1-2 mm. long pedicels are often equal to one another or to the flowers. The species came from the "Mts. Apalaches" (Appalachian Mts.) and I believe it most probable that this binomial belongs in the synonomy of *L. minor*.

19. *Lechea uniflora* Raf., New Fl. N. Am. 1: 96. 1836.

Leggett (1878: 249) was unable to suggest what species Rafinesque was describing based upon 3-4 inch specimens from the mountains of Maryland possessing few leaves or flowers and longer outer sepals than inner and with a 6-seeded, globose capsule. Grosser (1903: 135) placed the binomial in the synonymy of *L. minor* L. but Hodgdon (1938: 61) disagreed with this placement concluding that it was "hopeless to try to identify this particular one of Rafinesque's Lecheas." I am in total agreement with Hodgdon for I too am unable to suggest the identity of *L. uniflora*. There are too many features mentioned in its original description which are at complete variance with the characteristics of *L. minor* for us to accept Grosser's identification. To my knowledge a "smooth" specimen of *L. minor* with globose 6-seeded capsules has not been reported.

20. *Lechea stellata* Raf., New Fl. N. Am. 1: 96. 1836

I am in complete agreement with Leggett's decision (1878: 251) that this description is "undoubtedly the *L. thymifolia*" of Michaux which is a synonym of *L. minor* L. The more diagnostic portions of Rafinesque's description seem to be as follows: "Pilose . . .leaves 3-4 nate petiolate elliptic mucronulate, upper leaves alternate lanceolate; racemes foliose, . . . ext. sepals very long, capsules ovate-

oblong." Both Grosser (1903: 135) and Hodgdon (1938: 61) considered *L. stellata* to be synonymous with *L. minor*, although the latter fails to place it formally in the synonymy of that species.

21. *Lechea sessiliflora* Raf., New Fl. N. Am. 1: 97. 1836.

Leggett (1878: 251) thought that the description accompanying this binomial might "possibly be *L. patula*" but no species known to him had sessile mature flowers. In spite of this, Index Kewensis equated Rafinesque's binomial with *L. patula* Legg. and Grosser (1903: 138) unquestioningly placed it in the synonymy of that species. Hodgdon (1938: 63) felt that Rafinesque's description could not be positively identified but that its sessile flowers and 3-9-seeded capsules obviously excluded the pedicellate, 1(2)-seeded *L. patula* as a possibility. However, since no *Lechea* is actually sessile, it would perhaps be only reasonable to interpret Rafinesque's description as "subsessile" and consider short-pediceled species as possibilities. Also, since no known species of *Lechea* possesses more than 6 seeds, we had best treat the 3-9-seeded condition attributed by Rafinesque to his subgenus *Eudiexa* as an obvious error. It is well to note that Rafinesque did not mention seed-number in his diagnosis of *L. sessiliflora*; seed number was stated only in conjunction with the characterization of the subgenus.

There are five species known to be common to both Florida and Alabama: *Lechea villosa* Ell., *L. minor* L., *L. patula* Legg., *L. leggettii* Britt. and *L. torreyi* Legg. ex Britt. The two last-mentioned of these can be discounted as possibilities since their external sepals are considerably shorter than the internal and the reverse is clearly described as the state of *L. sessiliflora*. *Lechea villosa* can be eliminated from consideration since its shaggy-villous stems could never be described as "adpressed pilose" while both *L. minor* and *L. patula* both fit that characteristic. Rafinesque's characterization of the species "branches diffuse virgate, leaves scattered . . . linear . . . ext. sepals linear not much longer . . ." all point most clearly to *L. patula* rather than to *L. minor*.

I believe that Leggett's suspicion as to the identity of *L. sessiliflora* has been fully confirmed. There is hence no reason not to take up *L. sessiliflora* Raf. which has forty-two years priority over Leggett's *L. patula*.

The remaining names proposed by Rafinesque are listed below:

Lechea linifolia Raf., Atl. Jour. 1: 18. 1832. *nom nud.*
Lechea paucifolia Raf., Atl. Jour. 1: 18. 1832. *nom. nud.*
Lechea mexicana Raf., Sylva Tell. 133. 1838.

Rafinesque provided this as a substitute name for *Helianthemum tripetalum* of Mexico no doubt because *tripetalum* was a pointless epithet in a genus characterized by three petals. The name is nomenclaturally superfluous and therefore illegitimate (Art. 63).

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GENTIANA PUBERULENTA SP. NOV., A KNOWN BUT UNNAMED SPECIES OF THE NORTH AMERICAN PRAIRIES[1]

JAMES S. PRINGLE

The species which for the past century has been known as *Gentiana puberula* is one of the showiest of the North American gentians; Curtis (1959) called it "by all odds the most beautiful member of this famed genus in Wisconsin," and described its flowers as "unrivalled in the clarity and intensity of their deep blue color." It is a characteristic species of mesic and xeric prairie communities from Ohio west to Manitoba and Arkansas, and has been collected as far east as western New York and Maryland, as far south as Louisiana, and as far west as the Black Hills of South Dakota. Some authors have designated this species the "Prairie Gentian"; others have used the translation "Downy Gentian", although the puberulence is so minute that it is not a conspicuous feature to the casual observer.

Gentiana puberula Michx. Fl. Bor.-Am. 1:76. 1803 was based on a specimen Michaux had collected at "Fort Cherokis" (Fort Massac) in present-day Massac County, Illinois, where he had spent part of the autumn of 1795. This specimen is preserved in the herbarium of the Laboratoire de Phanérogamie, Muséum National d'Histoire Naturelle, Paris, France. A photographic negative of this specimen was made available through the kindness of Prof. A. Aubréville and J. Leandri. This negative and enlarged prints have been placed in HAM. Duplicate prints have been deposited

[1]In addition to those persons whose contributions are noted in the text, I should like to express my appreciation to Dr. A. J. Sharp of the University of Tennessee and Dr. J. M. Gillett and Mr. W. J. Cody of the Plant Research Institute, Canada Department of Agriculture, for their reviews of the manuscript, and to Dr. A. H. Moser of the University of Tennessee, for his checking the Latin description.

Contribution No. 5 from the Royal Botanical Gardens, Hamilton, Ontario, Canada.

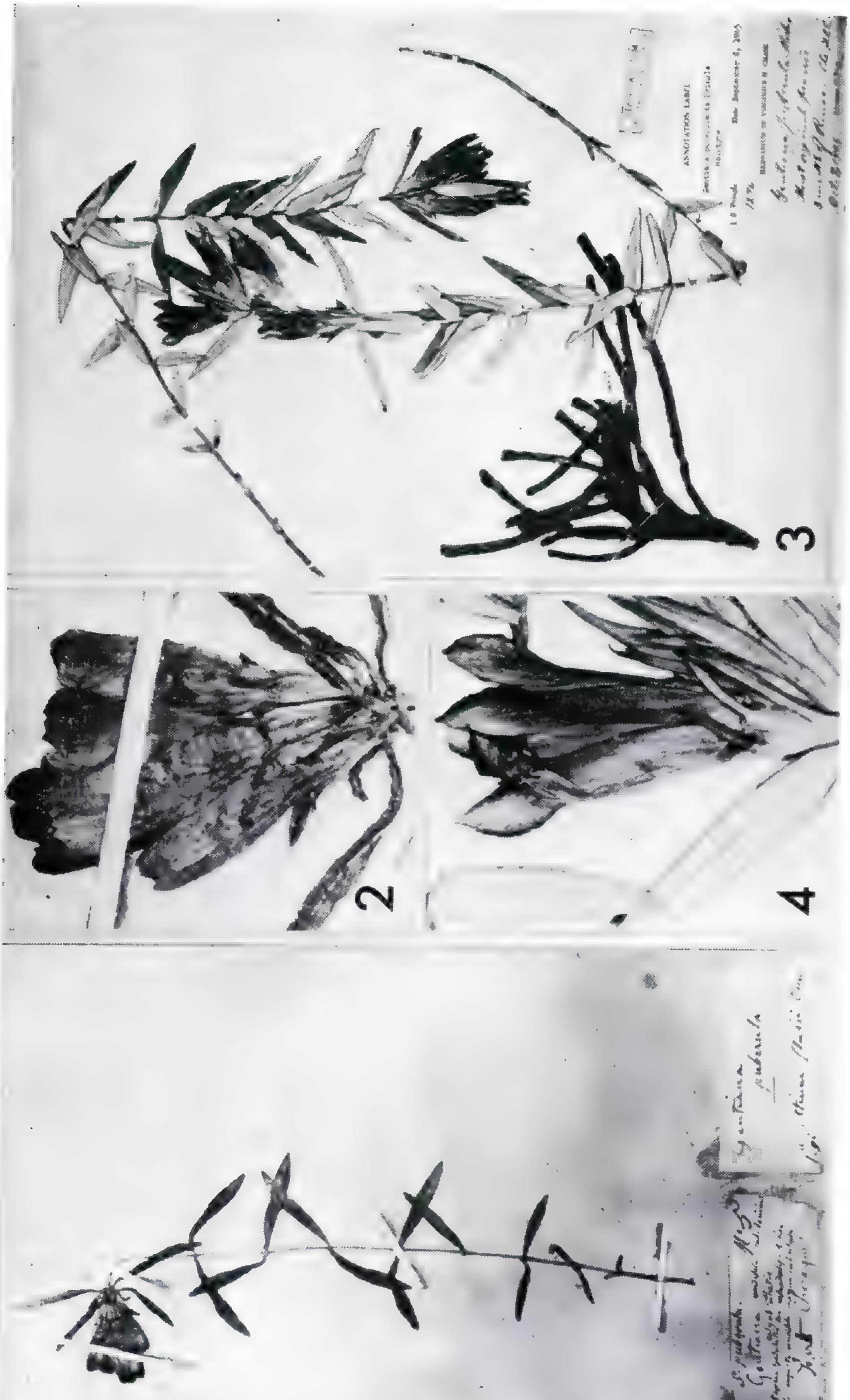

PLATE 1334

FIGS. 1 and 2. Type specimens of *Gentiana puberula* Michx. FIG. 1. Specimen and labels, X ca 0.2. FIG. 2. Flowers, X ca 0.9. FIGS. 3 and 4. Type specimen of *G. puberulenta* Pringle. FIG. 3. Complete specimen on herbarium sheet, with labels, X ca 0.2. FIG. 4. Flower on stem selected for type, X ca 0.9.

in DAO, GH, ILL, and WIS, and are reproduced here as Figures 1 and 2. The status of this specimen as the type is confirmed by the label in Michaux's handwriting on which both the collection data and the description correspond closely to those in Michaux's (1803) Flora Boreali-Americana.

The type specimen of *G. puberula* Michx. is clearly not a specimen of the species described under that name in recent manuals (e.g. Fernald, 1950, and Gleason & Cronquist, 1963), but is, instead, a specimen of *G. saponaria* L. which falls well within the range of variation commonly found in populations of that species. *Gentiana saponaria* is usually described as having glabrous stems, but individuals with puberulent stems are occasionally encountered throughout most of its range. Table 1 lists some of the conspicuous differences between the type specimen of *G. puberula* Michx. and the species hitherto commonly known as *G. puberula*, here designated *G. puberulenta*. The characters selected for use in Table 1 are those readily discernible in the photograph and ones which have been found valuable in the distinguishing of *Gentiana* species.

No scientific name appears to be available for the Prairie Gentian. Authors of floras of North America and treatises on the North American gentians published prior to 1848 seem not to have known this species (with the possible exception of Rafinesque, as noted below). Grisebach (1838, 1839, 1845), in his works on the Gentianaceae, tentatively assigned the name *G. puberula* Michx. to the synonymy of his *G. saponaria β linearis*. (The latter name was based on *G. linearis* Froel., the name of a distinct species with which Grisebach had confused narrow-leaved specimens of *G. saponaria*.) In so doing, Grisebach was following Pursh (1814), but he (1838) added that this interpretation might be incorrect, and that "it is desirable that this question should be determined by the inspection of Michaux's herbarium." From labels on mid-nineteenth-century collections of the Prairie Gentian, it appears that the first botanists to collect it called it *G. rubricaulis* Schwein. (a name properly applied to a more northern species), and that it is the basis

for the inclusion of "*Gentiana rubricaulis*" (without description) in some plant lists of that period (see Jones and Fuller, 1955).

Although many names for gentians were published by Rafinesque, it does not appear that any can be applied to this species. In certain parts the brief descriptions of *Gentiana shortiana*, *G. torreyana*, *G. rigida*, and *G. gracilis* (all in his Medical Flora, 1828) suggest the possibility that they were based on specimens of this species; however, each of the descriptions, when considered in its entirety, appears much more probably to have been based on *G. saponaria* L. In Rafinesque's (1837) Flora Telluriana these specific epithets appear in his genera *Pneumonanthe* and *Xolemia;* the descriptions of both genera contain material which is inapplicable to the Prairie Gentian, although applicable to *G. saponaria*. Probably Rafinesque never encountered this species, which was rare in the area of his field work and had been collected by few botanists at the time of his publishing. It is highly unlikely that any of these Rafinesque taxa will ever be typified by a specimen, since very few of the plant specimens collected by Rafinesque are extant. Dr. Ronald L. Stuckey, who has studied the herbarium (now in PH) of C. W. Short, to whom Rafinesque gave some specimens, reports that none of the specimens bear any of these names. John Torrey's *Gentiana* specimens (now in NY) were annotated by Rafinesque, but I found none of these names among the annotations.

Probably the earliest published description of the Prairie Gentian is that by Gray (1848) in the first edition of his Manual, in which it was designated *G. saponaria β puberula* (Michx.) Torr. & Gray. In later editions Gray recognized this taxon at the rank of species, as *G. puberula* Michx. Gray's treatment has generally been followed by later authors.

Thus, even though a number of descriptions of the Prairie Gentian have been published in the past, it is necessary to describe it here as a new species:

Gentiana puberulenta Pringle, sp. nov.

Herba perennis singulis vel pluribus caulibus suberectis longis 1-6 dm puberulentis subtiliter abundanterque. Folia lanceolato-oblonga interdum paene linearia prope basem latissima uninervia marginibus ciliatis saepe revolutis. Folia superiora longa 1.5-7 (-10.5) cm lata 4-18 (-30) mm. Flores paene sessiles 2-bracteati aggregati apud summum caulem et interdum de axillibus pedicellati. Tubus calycis longus 7-18 mm. Lobi calycis lineares longi 4-18 (-25) mm lati 1-3 (-4) mm. Corolla atrocyanea (raro violacea vel rubro-violacea) vasiformis certe se aperiens longa 3-6 cm. Lobi corollae ovati patentes longi 6-14 mm lati 4-10 mm marginibus saepe erosis. Partes liberae appendicium corollae longae 2.5-6 mm bifidae praeterea segmentibus laciniatis. Antherae non cohaerentes. Semina alata.

Type: *Chase 1276*, 3 mi. N.E. of Princeville, Peoria County, Illinois, 7 Oct. 1906 (ILL; *isotypes* DAO, ILL, KSC, MIN, NY, US).

A more extensive description of this species, along with a discussion of its distribution and probable relationships to other species, will be included in a forthcoming monograph by the author on *Gentiana*, section Pneumonanthae, in eastern North America.

No infraspecific taxa have been recognized within this species. The two named hybrids involving it are both typified by specimens, so the applications of the names *G.* × *billingtonii* Farw. (pro sp.) (Pap. Mich. Acad. 1:96. 1923) and *G.* × *curtisii* Pringle (Trans. Wis. Acad. 53: 277. 1964) remain unchanged. Their formulae, however, should be emended to *G. puberulenta* × *G. andrewsii* and *G. puberulenta* × *G. alba*, respectively.

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TABLE 1. THE TYPE SPECIMEN OF GENTIANA PUBERULA MICHX. CONTRASTED WITH G. PUBERULENTA PRINGLE

Type specimen of *G. puberula*	*G. puberulenta*
Leaves few and widely spaced.	Leaves many and crowded.
Leaves widest at or above the middle.	Leaves widest near the base.
Calyx lobes oblong, widest above the middle.	Calyx lobes linear.
Corolla lobes comprising about 10% of the total corolla length.	Corolla lobes comprising 20-25% of the total corolla length.
Corolla lobes widest at the base, less than twice as long as the appendages.	Corolla lobes ovate, more than twice as long as the appendages.

NEW CHROMOSOME NUMBERS IN ZINNIA AND SANVITALIA

ANDREW M. TORRES[1]

In recent systematic papers concerning *Zinnia* (Torres 1962, 1963) and *Sanvitalia* (Torres 1964) the author was unable to provide chromosome counts for 1 of the 17 species of *Zinnia* and for 3 of the 7 species of *Sanvitalia.* The *Zinnia* species, *Z. purpusii,* had been known only from the state of Chiapas in Mexico. Because the collection site, "Hacienda Monserrate", was not, and still is not, located and because the species was known only from the type collection, it was surprisingly pleasant to find a population on the hillsides of gravelly soil along Mexican Highway 190, 1.6 miles east of the Oaxaca-Chiapas border *(1739)* and again 12 miles east of the same border *(1743).* From the first collection the chromosome number of $n = 12$ was determined. Meiosis was regular. Its chromosome number, although predictable, was of interest because its nearest phenetic ally, *Z. maritima,* is also $n = 12$. Yet several other near allies are $n = 11$. The count is significant also since chromosome numbers of all species are now known.

A few more collections of *Sanvitalia tenuis* had been made than of *Z. purpusii* yet its habitat too was relatively inaccessible. It apparently grows only on the eastern side of the Sierra Madre Occidental in western Chihuahua. Some 12 miles west of Miñaca (near Ciudad Guerrero and La Junta) in Chihuahua near the edge of oak-pine hills, I chanced upon a population of some 20-25 young plants just beginning to flower. Interestingly, all my collections were from the base of young oak trees on gentle slopes in gravelly soil. During the rainy season when *S. tenuis* is in flower the area is accessible by logging roads and only in high-center vehicles. An anomalous chromosome number pattern had already been established for *Sanvitalia* because the species are $n = 8$ or 16, except for *S. abertii* which is

[1]Field work was supported by NSF grant GB-3842.

$n = 11$. It therefore became of especial interest to obtain the number of *S. tenuis* to see if it formed a link in a possible aneuploid series or if it was also $n = 8$, 16 or 11. Its chromosome number is $n = 9$; meiosis appeared regular. Perhaps one of the two species as yet uncounted, Mexican *S. fruticosa* and South American *S. versicolor*, will fill the $n = 10$ gap.

Voucher specimens of both species will be housed at KANU with duplicates at MSC.

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TWO NEW NAIADS FROM ILLINOIS AND DISTRIBUTIONAL RECORDS OF THE NAIADACEAE[1]

PAUL L. FORE[2] AND ROBERT H. MOHLENBROCK[3]

In the process of identifying Illinois species of *Naias* and in comparing fresh material with herbarium specimens, it was discovered that considerable misidentifications of specimens of this genus existed in Illinois. In order to present an accurate account of *Naias* in Illinois, and to up-date

[1]An additional species *Najas marina* L. is reported from Illinois by Winterringer in this number of Rhodora (p. 221).

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distributional data of the species, the first author undertook this study of Naiadaceae of Illinois.

GEOGRAPHICAL CONSIDERATIONS

Clausen (1936), summarizing the geographical distributions of *Naias*, listed five species from the northern United States, two of which were known from Illinois. Likewise, Winterringer and Evers (1960) and Jones (1963) recorded only the occurrence of the same two species, *N. flexilis* (Willd.) Rostk. & Schmidt and *N. guadalupensis* (Spreng.) Magnus. The results of this investigation demonstrated that four species of *Naias* inhabit Illinois waters. Lawrence (1955) stated that a total of seven species were native to the continental United States out of a world-wide total of approximately forty species.

Two Illinois species have a general distribution in eastern North America from Newfoundland to Minnesota, south to Missouri and Virginia. Included here are *Naias flexilis* and *N. gracillima* (A. Br.) Magnus.

The remaining two species exhibit quite dissimilar ranges. *Naias guadalupensis* is known from Massachusetts to South Dakota, south to Texas and Florida, and Tropical America. *Naias minor* All., an introduced Eurasian species, is locally established in New York and West Virginia, according to Fernald (1950); this species is also reported by Muenscher (1944) to occur in Alabama and Tennessee. In addition to the above localities, *Naias minor* is now recorded from Illinois.

In Illinois, *Naias flexilis* is widely distributed, although not abundant, throughout the state; *N. guadalupensis* is found mainly in the western and southern parts of the state.

Naias gracillima, mostly distributed in southern Illinois, was recently rediscovered in three counties. The first recent specimen was collected in Williamson County in 1952 (although heretofore unreported), while the other two were found during 1961. Fernald (1945) reported that a specimen of *Naias gracillima* from Wabash County was listed in the Patterson Catalogue in 1876. Apparently, more than

76 years have elapsed since this species was originally collected in Illinois.

Possibly an adventive, *Naias minor* was discovered in June, 1963, in shallow alkaline waters of Lake Murphysboro in Jackson County. This naiad was growing in close association with *Naias flexilis*, *N. guadalupensis*, *Chara* spp., and *Jussiaea diffusa* in an aquatic community commonly dominated by *Potamogeton americanus*. *Naias minor*, which is known only from this station, represents a new record for Illinois.

Vascular plants such as *Naias* species are naturally occurring aquatics that were considered originally to have a valuable role in inland waters. Today, it is recognized that profuse submerged vegetation in ponds and lakes creates serious nuisance problems, particularly around aquatic recreational facilities, fish hatcheries, and drainage canals. Also, abundant clumps of *Naias* offer excessive escape cover to small fishes which may lead to over-population and stunting. For these reasons, dense stands of *Naias* are now often controlled chemically (Benson and Conner, 1956).

TAXONOMY OF NAIAS MINOR

Because of the lack of a detailed description of *Naias minor* in current manuals in the United States, an account of this species is presented here.

Naias minor All. Fl. Pedem. 2:221. 1875.

Slender to terminally compact annuals; stems slender, but slightly stouter than in *Naias gracillima*, moderately branched, the terminal nodes crowded, with lime-green internodes; leaves filiform, colored the same as the internodes, 2.0-3.5 cm long, 0.2-0.3 mm wide, the distal end spinescent, recurved, the sheath abruptly distended, truncate, finely toothed, each leaf-margin with 8-16 barely macroscopic spinules more than 0.5 mm long; style and 2 stigmas 1.0-1.4 mm long; epicarp purplish; achene falcate, slender, oblique, 2.6-3.6 mm long, ¼ as wide, marked with 10-18 regular vertical ribs of broad, rectangular reticulations.

Although both *Naias minor* and *N. gracillima* typically have long filiform leaves with suddenly abrupt bases and spiny margins, *N. minor* is unique with respect to the

regular, rung-like pattern on the achenes. These markings usually consist of 12 parallel longitudinal rows of wider than high, rectangular areolae.

In the field, *N. minor* is quite distinctive due to its branched, erect, bushy appearance, long narrow leaves, and pale, lime-green coloration which easily distinguishes this plant from its darker green, wider-leaved associates. Although growing to heights of 1-2 feet, *N. minor* is nevertheless a rather fragile plant with stiffish leaves and stems so brittle that they fragment readily at the nodes.

DISTRIBUTIONAL RECORDS OF ILLINOIS NAIADACEAE

County distributional data for the four species of *Naias* in Illinois are given below.

Naias flexilis (Willd.) Rostk. & Schmidt.

Specimens examined. — COLES: Fox Ridge State Park, *Anderson 11386* (ISM). COOK: Cedar Lake, *Roush 814* (MO). JACKSON: Lake Murphysboro, *Weber s.n.* (SIU). JERSEY: Lake of Grafton, *Evers 38870* (ILLS). LAKE: Lake Marie, *Winterringer 2671* (ISM). LEE: Amboy, *Long 624* (ILL). MCHENRY: Crystal Lake, *Pepoon 11425* (ILLS). MASON: Sand Lake near Havana, *Richardson s.n.* (ILLS). MENARD: Without locality, *Hall 2* (ISM). PERRY: 4 miles W. of Du Quoin, *Bell s.n.* (SIU). RANDOLPH: Sinkhole N. of Chester, *Evers 32786* (ILLS). ST. CLAIR: East St. Louis, *Eggert 4258* (ILL). TAZEWELL: Spring Lake, *Chase 15843* (ILL). WABASH: Mt. Carmel, *Schneck 91* (ILL). WILLIAMSON: Strip mine area near Cambria, *Bell 4581* (SIU).

Naias guadalupensis (Spreng.) Magnus.

Specimens examined. — JACKSON: Along shore in shallow water of Lake Murphysboro, *Fore & Stookey 105* (SIU). JEFFERSON: Mt. Vernon Reservoir, *Fore & Stookey 301* (SIU). LAKE: Honey Lake, 4 miles N. of Barrington, *Steyermark 63897* (ILL). MACOUPIN: Riniker Lake near Carlinville, *Adams 11429* (ISM). PEORIA: Douglas Lake, *without collector s.n.* (ILLS). PERRY: Du Quoin City Reservoir, along the shore, *Fore & Stookey 304* (SIU). POPE: Lake Glendale, 2 miles N. of Dixon Springs State Park, *Fore & Andrews 302* (SIU). RANDOLPH: Coulterville Reservoir, *Fore & Stookey 303* (SIU). ST. CLAIR: Farm N. of Little Rolling Mill, *Eggert s.n.* (MO). TAZEWELL: Spring Lake, *Evers 39969* (ILLS). WILLIAMSON: Shallows of Crab Orchard Lake, *Voight 441* (SIU).

Naias gracillima (A. Br.) Magnus.

Specimens examined. — FORD: Hoppler Pond, *Hilterbran s.n.*

(ILLS). JACKSON: Fountain Bluff Fish Farm near Gorham, *Lewis s.n.* (SIU). WILLIAMSON: Crab Orchard Lake, *Evers 34356* (ILLS).

Naias minor All.

Specimens examined. — JACKSON. Shallow water of Lake Murphysboro, *Fore & Stookey 104* (SIU), *108* (SIU).

The authors express their appreciation to the curators of the following herbaria for the congenial cooperation and assistance shown them during this study: University of Illinois (ILL), Illinois Natural History Survey (ILLS), Illinois State Musem (ISM), Missouri Botanical Garden (MO), and Southern Illinois University (SIU).

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WINTERRINGER, G. S. and R. A. EVERS. 1960. New records for Illinois vascular plants. Ill. State Mus., Sci. Pap. Ser. **11**: 1-135.

AQUATIC VASCULAR PLANTS NEW FOR ILLINOIS

A project involving collection and identification of submersed and floating aquatic plants was undertaken jointly by the Illinois State Museum and the Illinois Department of Conservation in 1964-65. Conservation biologists of the Division of Fisheries collected aquatic plants from hundreds of lakes, ponds and rivers throughout the state. In October 1965, at the close of the project, 1175 collections had been made. A uniform data sheet was included with each collection to insure accurate locality records for all specimens. The plants, sent by mail in heavy envelopes to the Illinois State Museum for study and processing, were kept moist in thin plastic bags. Notes on the data sheet enclosed in each bag, or with each collection, were made in pencil to prevent smudges. These data sheets were dried, numbered and filed for reference. Alvin Lopinot of the Department of Conservation and the writer are preparing a field manual to assist biologists and students in the identification of submersed and floating aquatic plants of Illinois. This manual will be particularly intended to help conservation biologists in the study and control of aquatic plants wherever their abundance interferes with fishing.

One result of the project described above was the identification of two submersed aquatic vascular plants new for Illinois. These plants are *Najas marina* L. and *Ruppia maritima* L. Specimens have been filed in the Illinois State Museum Herbarium.

Collection data are as follows: LAKE CO., *Najas marina* L., 2½ mi. NE. of the village of Grayslake. Submersed in 3 feet of water in Druce Lake. The plants were abundant and established over a large area. The clear water of this glacial lake had a pH of 8.4. Oct. 5, 1964, *G. S. Winterringer 22499* and *22503*. In Wooster Lake, 1 mi. SW. of the village of Long Lake, Aug. 4, 1965, *Ben L. Dolbeare 311* and *312*. Originally collected in the Druce Lake locality, but not identified, by *Gregg Tichacek*, Sept. 9, 1964. VERMILION CO., *Ruppia maritima* L., 3 mi. NE. of Oakwood, Kickapoo State Park, in a strip mine pond called "Inland Sea". Abundant along the shallow margin of the pond and apparently established in water with a pH of 8.5. Sept. 18, 1964, *G. S. Winterringer 22449* and *22451*. Originally collected in the same locality, but not identified, by *Rudy Steinauer*,

Sept. 9, 1964. LAKE CO., *R. maritima* L., growing in Lake Zurich near Lake Zurich village. Sept. 28, 1965, *Alvin Lopinot.*

A third aquatic plant found recently in Illinois, *Najas minor* All., was reported in 1964 by Stookey, Fore and Mohlenbrock in *Castanea:* 29, pages 151 and 153. This naiad was first brought to the writer's attention in October 1963 by Alvin Lopinot who had collected it in Wayne and Greene counties. The museum herbarium now has specimens of *N. minor* from 31 additional counties in the southern three quarters of Illinois, extending southward from Henderson and Iroquois counties.

Procedure of handling specimens in the laboratory may be of interest. Each collection, with its numbered data sheet, was placed in plastic ice cream containers or floated in the sink during examination. Identification was made easier by working with fresh and mature specimens. In preparing material for mounting we used a technique of floating delicate species, e.g., *Zannichellia palustris* L., on letter size bond paper. The film of water on the paper and specimen permitted final arrangements of the material by moving it with a small brush. The sheet of paper with the specimen was lifted carefully to remove most of the water, or the sink was slowly drained before lifting the sheet. The bond paper bearing its specimen was numbered from the corresponding data sheet, placed on blotting paper or drying sheets and finally inserted in a folder of newsprint. Thus, a press of wet specimens was ready for the dryer. When specimens on bond paper were thoroughly dry they were pasted on standard herbarium sheets to avoid additional handling of the dried specimen. Drops of Duco cement or very narrow strips of gummed cloth were used to secure loose parts wherever needed. The cement also permitted fastening loose achenes of *Potamogeton* and fruiting parts of various other species. We have added approximately 2000 sheets of aquatics to the museum herbarium as a final result of the work described above.

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ILLINOIS STATE MUSEUM, SPRINGFIELD

STUDIES IN THE FLORA OF BOLIVIA — IV.

ROBERT C. FOSTER

Continued from Vol. 68, No. 773

11. Briza L.

See Parodi in Revist. Fac. Agron. Vet. Buenos Aires, 3: 113-158 (1920).

Perennials, the erect culms 2-8 dm. high. Leaves chiefly basal, much shorter than the inflorescence, glabrous, often scabridulous, 1-2 mm. wide. Inflorescence a loose to dense racemose panicle. Spikelets oblong-elliptic, longer than broad, but the shorter ones verging on the suborbicular, usually many-flowered, the crowded florets erect to nearly horizontal, the naked rachilla disarticulating above the glumes; glumes subequal, the margins scarious, awnless; lemmas awnless, more or less wing-margined and closely imbricate.

Lemmas, and often the glumes, tuberculate-scabrid; lemmas about 2 mm. long; palea glabrous. ..... 1. *B. Mandoniana.*

Lemmas and glumes not tuberculate-scabrid; lemmas to 5 mm. long; palea covered with gland-tipped hairs. ..... 2. *B. paleapilifera.*

1. **Briza Mandoniana** (Griseb.) Henrard in Meded. Rijks Herb. Leiden, no. 40: 70 (1921). *B. Mandoniana* var. *tuberculata* Henrard in Meded. Rijks Herb. Leiden, no. 40: 71 (1921). *B. Mandoniana* var. *Herzogiana* Henrard in Meded. Rijks Herb. Leiden, no. 40: 71 (1921). *B. Mandoniana* var. *vallegrandensis* Henrard in Meded. Rijks Herb. Leiden, no. 40: 71 (1921). Spikelets 3-5 mm. long, oblong-elliptic, with up to 8 florets. Glumes 2-2.5 mm. long, broadly ovate, often scabrid to tuberculate, the scabrid apex somewhat erose, the basal margins shortly ciliate. Palea shorter than the lemma, bicarinate, the keels ciliolate. LA PAZ: LARECAJA: vic. Sorata; Lacatia and Lancha de Cochipata, 3200-3600 m., *Mandon* 1356 (GH; type-number); Cerro del Iminapi, 2650 m., *Mandon* 1355 (GH); Sorata, 4300 m., *Rusby* 238 (GH); NOR YUNGAS: Pongo, 3640 m., *Hitchcock* 22773 (GH).

2. **B. paleapilifera** Parodi in Revist. Fac. Agron. Vet. Buenos Aires, 3: 124, fig. 2, no. 5 (1920). *B. stricta* of the Catalogue.* Plants to 6 dm. high. Leaf-blades to 2 mm. wide, glabrous to slightly scabridulous above and beneath. Panicle 7-12 cm. long, the rachis, branches and pedicels scabrid, at least in part. Spikelets oblong-elliptic, to 7 mm. long, to 8-12-flowered. Glumes to 4.5 mm. long, broadly ovate, 5-7-nerved, subacute to obtuse. Lemmas to 3-5 mm. long, subquadrate, the apex coarsely 3-lobed, the lateral lobes broad, obtusely rounded,

*The Catalogue refers to A Catalogue of Ferns and Flowering Plants of Bolivia, in Contrib. Gray Herb. no 184 (1958).

the central lobe triangular, acute, keel prominent, thickened, the lateral nerves with a basal vertical line of short, thick, unicellular hairs. Palea oval, subacute to obtuse, about 2 mm. long, the dorsal surface with numerous short gland-tipped hairs, bicarinate, the keels narrowly winged, short-ciliate. COCHABAMBA: CERCADO: Cochabamba, *Holway* 383 (US).

The Holway collection is the basis on which Hitchcock ascribed *Briza stricta* to Bolivia in his treatment of the Andean grasses. No Bolivian material of *B. Stricta* has been seen.

Briza spicigera (Presl) Steud. Nomencl. (ed. 2) **1**: 225 (1840). No material has been seen from Bolivia, but it has been ascribed to that country by Pilger in Notizbl. **11**: 780 (1933). The basis for this consists of two Troll collections, no. 632 from CHUQUISACA: TOMINA: Alto de Escalón, and no. 834, from the Alto de Cuchilla, which I have been unable to locate. If the species should be found, it can be distinguished by the laterally compressed lemmas which are finely and densely papillate, emarginate at the apex, with the markedly thickened and prominent keel excurrent as a short thick mucro or cusp. The species is apparently identical with *Briza uniolae* (Nees) Nees ex Steud. Syn. Pl. Glum. **1**: 283 (1854). If this is the case, the latter name should be applied to it, for its basionym, *Eragrostis uniolae* Nees, was published a year earlier than the basionym of *Briza spicigera, Chascolytrum spicigerum* Presl. It has been illustrated by Parodi, l. c., under the name *Briza uniolae*.

12. **Eragrostis** Beauv.

Annuals or perennials, from very low mat-forming plants to erect plants up to 2 m. high. Leaves flat or involute, seldom equaling or exceeding the inflorescence at maturity. Inflorescence a terminal racemose panicle, from dense, with erect compact branching, to very open, with freely and widely spreading branches, the spikelets 2-36-flowered disarticulating above the awnless glumes, the rachilla usually glabrous. Lemmas awnless, occasionally the lowermost sterile, but sterile and reduced florets usually borne at the tip, the paleas usually persistent on the rachilla after the fall of the lemmas and caryopses.

a. Palea long-ciliate, the conspicuous hairs up to 1 mm. long. ..... 1. *E. ciliaris.*

a. Palea short-ciliate at most, the hairs inconsicuous.
  b. Largest spikelets at least 1 cm. long.
    c. Axils of inflorescence, at least the lowermost, pilose.
      d. Glumes equal or subequal.
        e. Glumes gland-dotted on keel, especially near the apex. .... 3. *E. cilianensis.*
        e. Glumes not gland-dotted on keel. ..... 12. *E. bahiensis.*

d. Glumes distinctly unequal. ..... 5. *E. maypurensis.*
c. Axils of inflorescence glabrous. ..... 2. *E. hypnoides.*
b. Largest spikelets less, usually much less, than 1 cm. long.
f. Axils of inflorescence glabrous.
g. Plants to 2 m. high, the leaf-blades to 6 mm. wide, scabridulous on both surfaces. ..... 4. *E. glomerata.*
g. Plants less than 1 m. high, the leaf-blades 2-3 mm. wide.
h. Glumes equal or subequal.
i. Spikelets 1 mm. wide, 2-6-flowered. ..... 7. *E. nigricans.*
i. Spikelets 2 mm. wide, with 7 or more florets. ..... 9. *E. mexicana.*
h. Glumes definitely unequal. ..... 13. *E. expansa.*
f. Axils of inflorescence, at least the lowermost, pilose to some extent.
j. Lemmas 1.5 mm. or less in length.
k. Largest spikelets 7 mm. long, with up to 12 florets. ..... 6. *E. articulata.*
k. Largest spikelets 5 mm. long, with up to 9 florets. ..... 11. *E. montufari.*
j. Lemmas 2 mm. or more in length.
l. Rachilla puberulent. .... 10. *E. lurida.*
l. Rachilla glabrous, or with 1-2 short hairs at most below a floret.
m. Leaf-blades glabrous beneath, scabridulous above. ..... 8. *E. pilosa.*
m. Leaf-blades at least sparsely pilose above.
n. Panicle to 20 cm. long, leaf-blades sparsely pilose. ..... 14. *E. lugens.*
n. Panicle to 3 dm. long, leaf-blades and sheaths densely pilose. ..... 15. *E. polytricha.*

1. **Eragrostis ciliaris** (L.) Link, Hort. Berol. 1: 192 (1827). Annual, to 4 dm. high. Leaf-sheaths long-pilose at apex, blades flat, to 4 mm. wide, sparsely long-pilose at base, scabridulous above. Panicle dense, interrupted below and often above, the rachis glabrous, branches and pedicels scabridulous. Spikelets about 3 mm. long, with up to 8 florets, the rachilla glabrous. First glume about 1 mm. long, 1-nerved, the keel scabridulous; second glume about 1.5 mm. long, 1-nerved, the keel scabridulous. Lowest lemmas 1.5 mm. long, 3-nerved, the lateral nerves submarginal, minutely scabridulous; width (folded) 0.5 mm. Palea shorter than lemma, the 2 keels long-ciliate, the hairs up to 1 mm. long. SANTA CRUZ: SARA: Dolores, *Steinbach* 1831 (GH).

2. **E. hypnoides** (Lam.) BSP. Prelim. Cat. N. Y. 69 (1888). Annual, often forming prostrate mats, culms to 1 dm. high. Leaf-sheaths ciliate and sparsely pilose at apex, the short blades to 2 cm. long, flat or somewhat involute, sparsely pilose above, glabrous beneath. Rachis and pedicels glabrous, or the pedicels with a few short hairs at

base or apex. Largest spikelets to about 1.5 cm. long, commonly about 1 cm. long, with up to 25 florets, the rachilla glabrous. First glume 1.5 mm. long, 1-nerved, the keel scabridulous; second glume to 2.5 mm. long, 1-nerved, the keel scabridulous. Lowest lemmas to 2.5 mm. long, 3-nerved, the keel scabridulous, width (folded) about 0.6 mm. Palea about 1 mm. long, the 2 keels distinctly ciliolate. BENI: CERCADO MOJOS: Trinidad, 200 m., *Cárdenas* 3536 (GH). LA PAZ: LA-RECAJA: Guanai, 650 m., *Rusby* 230 (GH). SANTA CRUZ: SARA: Palometilla, *Steinbach* 2914 (GH).

3. **E. cilianensis** (All.) ex Vign. Lut. in Malpighia, 18: 386 (1904). Annual, to 5 dm. high, but usually shorter, the leaf-sheaths ciliate, pilose around the apex, the blades flat, to 4 mm. wide, scabrid-ciliate, otherwise glabrous. Panicle to 1 dm. long, fairly compact, the rachis glabrous, the pedicels usually scabridulous. Spikelets to 1 cm. long, with up to 20 florets, the rachilla glabrous. Glumes equal, to 1.5 mm. long, 1-nerved, the nerve with 1-2 glandular dots and scabridulous at the apex. Lowest lemmas about 2 mm. long, 3-nerved, the keel gland-dotted and scabridulous at the apex, scabridulous between lateral nerves and margin, width (folded) 1 mm. Palea about 1.5 mm. long, the 2 keels ciliate. Bolivian Plateau: *Bang* 1078 (GH). COCHABAMBA: CERCADO: Cochabamba, 2700 m., *Eyerdam* 24882 (GH). SANTA CRUZ: SARA: Buenavista, *Steinbach* 1944 (GH).

4. **E. glomerata** (Walt.) L. H. Dewey in Contrib. U. S. Nat. Herb. 2: 543 (1894). Annual, to 2 m. high. Leaf-sheaths glabrous, the long-attenuate flat blades to 30 cm. long and 6 mm. wide, scabridulous on both surfaces. Panicle to 4 dm. long, narrow, the branches erect, appressed, rachis and pedicels scabridulous. Spikelets about 3 mm. long, or less, with up to 7 florets, the rachilla glabrous. Glumes equal, 1 mm. long or less, 1-nerved, the keel sparsely scabridulous. Lowest lemmas about 1 mm. long, 3-nerved, the keel scabridulous, width (folded) less than 0.5 mm. Palea about 0.5 mm. long, the keels short-ciliate. LA PAZ: SUR YUNGAS: Covendo, *White* (M. E.)* 915, 1000 (Hitchcock).

5. **E. maypurensis** (HBK.) Steud. Syn. Pl. Glum. 1: 276 (1854). Annual, to 3 dm. high, leaves mostly basal, short, the sheaths pilose, the narrow blades pilose, at least when young. Panicle to 15 cm. long, the rachis and pedicels glabrous to pilose. Spikelets very variable, the largest 1-2.5 cm. long, with up to 36 florets, the rachilla glabrous. First glume to 2.5 mm. long, 1-nerved; second glume to 3 mm. long, 3-nerved, broader than the first. Lowest lemmas to 3 mm. long, long-acute or acuminate, 3-nerved, the keel scabridulous, width (folded) 1 mm. Palea nearly 2 mm. long, the keels short-ciliate.

*The initials M. E. refer to collections made on the Mulford Biological Exploration. The number-series of these collections duplicates other number-series of the same collectors.

SANTA CRUZ: SARA: Dolores, near Buenavista, 500 m., *Steinbach* 6138 (GH).

6. **E. articulata** Nees, Agrost. Bras. 502 (1829). Annual, to 4 dm. high. Leaf-sheaths sparsely pilose, the flat, short blades 2-4 mm. wide, densely papillose-hispid, especially beneath. Panicle usually about half the total length of culms, open, the branches distant, the rachis glabrous, branches and pedicels sparsely scabridulous. Largest spikelets to 7 mm. long, 1 mm. wide, with up to 12 florets, the rachilla glabrous. First glume 1 mm. long, 1-nerved, the keel scabridulous; second glume about 1.5 mm. long, obscurely 3-nerved, the keel scabridulous. Lowest lemmas about 1.5 mm. long, 3-nerved, width (folded) 0.5 mm. Palea shorter than lemma, bicarinate, the keels glabrous, the margins finely ciliolate. COCHABAMBA: MIZQUE: near Vilavila, 2700 m., *Eyerdam* 24965 (GH). SANTA CRUZ: SARA: Buenavista 500 m., *Steinbach* 5182, 6142, 6991 (all GH).

Eragrostis articulata var. *glabrescens* Henrard in Meded. Rijks Herb. Leiden, no. 40: 69 (1921) was distinguished as having glabrous leaves. According to Hitchcock (Contrib. U. S. Nat. Herb. **24**: 338), the "spikelet is more slender and has more florets than those of *E. articulata*, and appears to belong to a distinct species."

7. **E. nigricans** (HBK.) Steud. Nomencl. (ed. 2) **1**: 563 (1840). *E. subatra* Jedw. in Mez, Bot. Arch. **5**: 202 (1924). Annual, the decumbent culms to 5 dm. long. Leaf-sheaths glabrous but pilose at the base of the blade, the blades flat, to 3 mm. wide. Panicle dark, to 2 dm. long, open, the branches spreading, rachis, branches and pedicels glabrous. Spikelets 4-6 mm. long, with 2-6 florets, the rachilla glabrous. Glumes equal, about 2 mm. long, the second broader than the first, the keels scabridulous. Lowest lemmas 2.5 mm. long, obscurely nerved, the keel slightly scabridulous, width (folded) 0.7 mm. Palea 2 mm. long, keels ciliolate. LA PAZ: MURILLO: La Paz, 3800 m., *Buchtien* 42 (GH), 3965 (GH), 3300 m., *Bang* 21 (GH), 80 (GH; type-number of *E. subatra*), *Pennell* 14216 (GH); Obrajes, 3300 m., *Buchtien* 562 (GH). POTOSÍ: SUR CHICHAS: Oploca, *Hitchcock* 22928 (GH).

8. **E. pilosa** (L.) Beauv. Ess. Agrost. 162 (1812). Annual, to 3 dm. high. Leaf-sheaths long-ciliate, pilose at apex, the flat blades about 2 mm. wide, scabridulous above, glabrous beneath. Panicle open at maturity, to 20 cm. long, rachis glabrous, the branches and pedicels often scabridulous. Spikelets to 5 mm. long, about 1 mm. wide, with up to 8 florets, the rachilla glabrous. First glume about 0.75 mm. long, 1-nerved, the nerve faintly scabridulous; second glume slightly over 1 mm., 1-nerved. Lowest lemmas about 2 mm. long, obscurely 3-nerved, the keel scabridulous, width (folded) about 0.5 mm. Palea somewhat shorter than the lemma, bicarinate. LA PAZ: LARECAJA: vic. Sorata; near Munaypata, 2650-2900 m., *Mandon* 1329 (GH); MURILLO: Obrajes, 3400 m., *Buchtien* 820 (GH). COCHABAMBA: CERCADO: Cocha-

bamba, 2560 m., *Cárdenas* 2471 (GH). SANTA CRUZ: SARA: El Limón, *Steinbach* 1786 (GH). TARIJA: ARCE: Padcaya, 2100 m., *Fiebrig* 2528 (GH).

9. **E. mexicana** (Lag.) Link, Hort. Berol. **1**: 190 (1827). Annual, to 4 dm. high. Leaf-sheaths ciliate, pilose at the apex, the blades flat, glabrous, 2-3 mm. wide. Panicle fairly open, the branches distant, to 30 cm. long, rachis glabrous, the branches and pedicels scabridulous. Spikelets to 7-8 mm. long, with 7 or more florets, the rachilla glabrous. Glumes equal or subequal, to 2.5 mm. long, the first 1-nerved, the keel scabridulous, the second obscurely 3-nerved, the keel scabridulous. Lowest lemmas to 2.5 mm. long, the keel scabridulous, apex obtuse to subacute, width (folded) 0.7 mm. Palea to 2 mm. long, the keels ciliate. LA PAZ: SUR YUNGAS: Sirupaya, *Buchtien* 428 in part (Hitchcock).

10. **E. lurida** Presl, Rel. Haenk. **1**: 276 (1830). Perennial, very variable in height, up to 1 m. tall. Leaf-sheaths ciliate and pilose at apex, the flat blades to 2 mm. wide, sometimes very sparsely pilose. Panicle to 3 dm. long, the primary branches distant, the rachis glabrous, pedicels finely scabridulous. Spikelets to 5 mm. long, 7-8-flowered, the rachilla puberulent. First glume 1.5 mm. long, keel scabridulous, the second glume 2 mm. long, the keel scabridulous. Lowest lemmas to 2.5 mm. long, 3-nerved, the scabridulous keel very prominent, emarginate at the obtuse apex, width (folded) 0.8 mm. Palea as long as lemma, the keels ciliate. LA PAZ: LARECAJA: vic. Sorata; Ullontiji, 2900 m., *Mandon* 1332 (GH; type-number of *E. bahiensis* var. *boliviensis*); MURILLO: near La Paz, 4000 m., *Rusby* 49 (GH), 3800 m., *Buchtien* (GH).

11. **E. montufari** (HBK.) Steud. Nomencl. (ed. 2) **1**: 563 (1840). *E. Buchtienii* Hack. in Fedde, Rep. Sp. Nov. **6**: 157 (1908). *E. boliviensis* Jedw. in Mez, Bot. Arch. **5**: 205 (1924). Perennial, to 6 dm. high. Leaf-sheaths pilose, at least at apex, the flat blades to 4 mm. wide, pilose above and beneath. Panicle 10-30 cm. long, the primary branches distant, rachis, branches and pedicels scabridulous. Spikelets to 5 mm. long, up to 9 florets, about 1 mm. wide, the rachilla glabrous except for an occasional short hair at the apex of a section. Glumes about equal, 1 mm. long, or a little more, 1-nerved, the keels scabridulous. Lowest lemmas 1.5 mm. long, rounded, obscurely nerved, the keel scabridulous at apex, width (folded) 0.5 mm. Palea about 1 mm. long, bicarinate, the keels glabrous, the margins ciliolate. LA PAZ: LARECAJA: vic. Sorata; Cerro del Iminapi, 2650 m., *Mandon* 1330 (GH; type-number of *E. boliviensis*); MURILLO: La Paz, *Bang* 201 (GH); Cotaña, 2450 m., *Buchtien* (GH). COCHABAMBA: CERCADO: Cochabamba, *Hitchcock* 22798 (GH).

12. **E. bahiensis** Schrad. ex Schult. Mant. **2**: 318 (1824). Perennial, to 8 dm. high. Leaf-sheaths pilose at apex, the blades 2 mm. wide, flat or somewhat involute, sparsely pilose. Inflorescence a lax to

compressed panicle, to 15 cm. long, the branches distant, the rachis glabrous, branches and pedicels scabridulous. Largest spikelets over 1 cm. long, 3-4 mm. wide, with up to 15 florets, the rachilla glabrous. Glumes subequal, about 2 mm. long, obscurely nerved, the keels scabridulous at apex. Lowest lemmas to 3 mm. long, 3-nerved, the keel very prominent and scabridulous at apex, width (folded) 1 mm. Palea 2 mm. long, bicarinate, the keels glabrous, the margins ciliate. LA PAZ: NOR YUNGAS: Coripata, *Hitchcock* 22681 (GH). SANTA CRUZ: SARA: Buenavista, 500 m., *Steinbach* 5184 (GH), 6881 (GH); Río Perdix, 400 m., *Steinbach* 6889 (GH).

13. **E. expansa** Link, Hort. Berol. 1: 190 (1827). Perennial, to 8 dm. high. Leaf-sheaths pilose at apex, the blades flat to involute, 2 mm. wide, scabridulous above. Panicle open, to 15 cm. long, primary branches distant, rachis glabrous, branches and pedicels scabridulous. Largest spikelets about 5 mm. long (in some non-Bolivian material to 1.5 cm.), 1 mm. wide, with up to 11 florets, the rachilla usually glabrous but occasionally with a few hairs. First glume 1 mm., the keel scabridulous; second glume 1.5 mm., the keel scabridulous. Lowest lemmas 2 mm. long, 3-nerved, the keel scabridulous at the apex, width (folded) 0.5 mm. Palea 1.5 mm. long, keels glabrous, margins ciliolate. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 6853 (GH); Río Perdix, 400 m., *Steinbach* 6899 (GH).

14. **E. lugens** Nees, Agrost. Bras. 505 (1829). *E. soratensis* Jedw. in Mez, Bot. Arch. 5: 213 (1924). Perennial, to 5 dm. high. Leaf-sheaths pilose to sparsely pilose and ciliate, to more or less glabrate, the blades flat to involute, usually sparsely pilose. Panicle open, to 20 cm. long, the primary branches distant, the rachis glabrous, branches and pedicels somewhat scabridulous. Spikelets 5 mm. long, or less, about 1 mm. wide, 5-6-flowered, the rachilla glabrous. First glume 1 mm., the second 1.5 mm. long, the keels scabridulous. Lowest lemmas 2 mm. long, obscurely nerved, the keel and apex slightly scabridulous, width (folded) 0.8 mm. Palea somewhat shorter than the lemma, keels glabrous, margins ciliolate. Yungas: *Bang* 307 (GH). LA PAZ: LARECAJA: Sorata, 3300 m., *Rusby* 239 (GH); Cerro del Iminapi, 2650 m., *Mandon* 1283 (GH); Sicasica, 2650-2900 m., *Mandon* 1331 (GH; type-number of *E. soratensis*). COCHABAMBA: MIZQUE: near Vilavila, 2500 m., *Eyerdam* 25021 (GH). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 7091 bis (GH).

15. **E. polytricha** Nees, Agrost. Bras. 507 (1829). Perennial, up to 1 m. high. Leaf-sheaths densely long-pilose, the blades flat to involute, densely long-pilose. Panicle to 3 dm. long, very open, the rachis, branches and pedicels scabridulous. Spikelets 5 mm. or less, 3-5-flowered, 1.3 mm. wide, the rachilla glabrous with occasionally a few short hairs below the florets. First glume 1 mm. long, the second, 1.5 mm., keels strongly scabridulous. Lowest lemmas to 2 mm. long, keel scabridulous, width (folded) 0.5 mm. Palea 1.5-2 mm.

long, margins ciliolate. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 6980 (GH).

13. **Distichlis** Raf.

Perennial, plants dioecious, rhizomatous, culms erect, from 3 to 30 cm. high. Leaves glabrous or glaucous or softly puberulent or even pilose, particularly on the sheaths, obviously distichous, shorter to longer than the inflorescence, blades usually folded or involute, 1 mm. wide or less. Inflorescence a terminal racemose panicle, the panicle somewhat condensed. Spikelets few- to many-flowered, the staminate spikelets of a rather softer texture than the pistillate, glumes present, the naked rachilla disarticulating above the glumes, the lemmas rather obscurely nerved.

a. Dwarf plants, less than 10 cm. high.
   b. Leaf-sheaths pilose, at least in part, blades usually glabrous; panicles of 1-3 spikelets, the panicle about 1 cm. long. ..... 1. *D. humilis.*
   b. Leaf-sheaths glabrous or very sparsely pilose at summit, blades glabrous or sparsely pilose when young; panicles longer than 1 cm., with more numerous spikelets. .. 2a. *D. spicata* var. *andina.*

a. Taller plants, up to 30 cm. high, panicles with numerous spikelets. ..... 2. *D. spicata.*

1. **Distichlis humilis** Phil. in Anal. Mus. Nac. Chile, 8: 86 (1891). Leaf-sheaths closely imbricate, the blades spreading, to 1 cm. long, or less. Spikelets barely or not at all exserted from leaves, to 7 mm. long, 3-6-flowered. Glumes equal to subequal, the second to 4 mm. long. Lemmas to 4.5 mm. long. Palea shorter than the lemma, bicarinate, the keels narrowly winged and minutely ciliolate. POTOSÍ: SUR CHICHAS: Atocha, *Hitchcock* 22876 (GH).

2. **D. spicata** (L.) Greene in Bull. Calif. Acad. Sci. **2:** 415 (1887). Plants generally much taller than the preceding, the leaf-blades much longer and often exceeding the inflorescence, the sheaths not closely imbricate. Panicle exserted from the leaves, to 7 cm. long. Spikelets to 1.8 cm. long and up to 20-flowered. Glumes unequal, the first to 1.5 mm. long, the second to 2.5 mm. Lemmas about 3.5 mm. long. Palea as long as the lemma, bicarinate. LA PAZ: MURILLO: La Paz, 3300 m., *Bang* 108 (GH). COCHABAMBA: CERCADO: Valle de Cochabamba, 2600 m., *Steinbach* 8745 (GH). POTOSÍ: SUR CHICHAS: Oploca, *Hitchcock* 22883 (GH), 22884 (GH).

2a **D. spicata** var. **andina** Beetle in Revist. Argent. Agron. **22:** 93 (1955). Differs in smaller size, short leaf-blades (to 2 cm.), shorter panicles, smaller and fewer-flowered spikelets. LA PAZ: MURILLO: San Jorge, 3550 m., *Buchtien* 8537 (GH).

Distichlis spicata gamma *marginata* (Phil.) O. Ktze. Rev. Gen. 3 (2) : 350 (1898) was recorded for Bolivia by Kuntze,

on the basis of a collection made by him. In view of some of Kuntze's notorious misdeterminations, I hesitate to accept it on such a basis alone.

14. **Arundo** L.

Arundo Donax L. Sp. Pl. 81 (1753). Rhizomatous perennial, the culms to 6 m. high, occasionally branched. Leaves very long, 3-7 cm. wide, the margins scabrid. Inflorescence a large, dense, terminal, drooping, racemose panicle to 6 dm. long. Spikelets to 1.2 cm. long, 3-4-flowered, the florets perfect, successively smaller upwards, the naked rachilla disarticulating above the glumes; glumes somewhat unequal, the first about 1 cm. long, the second 1.4 cm., as long as the spikelet; lemmas about 1 cm. long, hyaline, strongly 3-nerved, apex 2-toothed with a central awn to 3 mm. long, the rounded back and sides densely long-villous; palea to 5 mm. long, obtuse, with 2 prominent marginal nerves, the margins densely ciliate. LA PAZ: NOR YUNGAS: Coroico, *Hitchcock* 22724 (US).

15. **Phragmites** Trin.

Phragmites communis Trin. Fund. Agrost. 134 (1820). Rhizomatous stoloniferous perennial, with culms to 4 m. high. Leaves long, to 5 cm. wide. Inflorescence a terminal, plumose, racemose, tawny panicle, the branches ascending, to 4 dm. long. Spikelets about 1.5 cm. long, 2-7-flowered, the long-villous rachilla disarticulating above the glumes; glumes unequal, the first nearly 5 mm. long, 3-nerved, the second, 6.5 mm. long, 5-nerved, much shorter than the spikelet; lowest floret staminate or sterile, the awnless lemma about 1.2 cm. long; upper florets perfect, the glabrous lemmas long-attenuate into a 6 mm. pseudo-awn; palea about 5 mm. long, acute, slightly bidentate, the margins ciliolate. CHUQUISACA: SUR CINTI: Camataquí, about 2500 m., *Fiebrig* 2954 (US).

16. **Cortaderia** Stapf

Large perennials, to 1.5 m. high. Leaves nearly as long as the culms, the blades to 1.5 cm. wide, the margins and midrib scabrous beneath, old leaf-bases coiled at base of plant. Inflorescence a large, terminal, plumose, racemose panicle. Spikelets unisexual or perfect, if unisexual the plants dioecious, 1-several-flowered, the glumes often as long as the spikelet, hyaline, the villous rachilla disarticulating above the glumes; lemmas hyaline, tapering to a long awnlike prolongation or bearing 2 such structures flanking a true awn.

Plants dioecious; lemma not bidentate, with 1 long pseudo-awn. ..... 1. *C. rudiuscula.*

Plants not dioecious; lemma bidentate, with 2 long pseudo-awns flanking a long true awn. ..... 2. *C. bifida.*

1. **Cortaderia rudiuscula** Stapf in Gard. Chron. (ser. 3) **22:** 396 (1897). Panicle yellowish or purplish, to 6 dm. long, the branches dense and drooping. Staminate spikelets about 1 cm. long, 2-3-flowered (occasionally 1-flowered). Glumes 6-8 mm. long, 1-nerved. Lemmas 5 mm. long, with a 6 mm. pseudo-awn, villous on the back and sides. Palea as long as the lemma. Pistillate spikelets about 1.2 cm. long, about 4-flowered. Glumes nearly equal, 8 and 9 mm. long, 1-nerved. Lemmas about 4 mm. long, the pseudo-awn about 6 mm. long, densely long-villous on back and sides. Palea as long as lemma, bicarinate, the keels ciliolate. LA PAZ: MURILLO: La Paz, 3750 m., *Buchtien* 507 (GH), *Shepard* 167 (GH), 3300 m., *Bang* 26 (GH); SUR YUNGAS: Chulumani, 1600 m., *Hitchcock* 22701 (GH). COCHABAMBA: CHAPARE: Incachaca, 2250 m., *Steinbach* 9493 (GH). POTOSÍ: CHICHAS: Quechisla, *Cárdenas* 98 (GH). SANTA CRUZ: SARA: quebrada del Río Blanco, Cerro Hosana, 1300 m., *Steinbach* 3372 (GH). TARIJA: CERCADO: Tarija, 2850 m., *Fiebrig* 2656 (GH); Paicho, 2900 m., *Fiebrig* 3043 (GH).

2. **C. bifida Pilger** in Engler, Bot. Jahrb. **37:** 374 (1906). *C. bifida* var. *grandiflora* Henrard in Meded. Rijks Herb. Leiden, no. 40: 67 (1921). Panicle yellowish to purple, about 2 dm. long, laxer than in *C. rudiuscula*. Spikelets of perfect florets, 3-4 in number, about 8-10 mm. long (excluding the awns). Glumes unequal, 7 and 9 mm. long, hyaline, 1-nerved, long-acute. Lemmas about 5 mm. long, the 2 teeth prolonged into pseudo-awns 6-18 mm. long, true awn 1.1-2.2 cm. long, lemma long-villous, primarily near the base. LA PAZ: MURILLO: Unduavi, 3200 m., *Buchtien* 2575 (GH). SANTA CRUZ: SARA: Cerro La Negra, 1800 m., *Steinbach* 8171 (GH).

17. **Gynerium** Humb. & Bonpl.

Gynerium sagittatum (Aubl.) Beauv. Ess. Agrost. 138 (1812). Large dioecious perennial, to 10 m. high. Leaf-blades to 2 m. long and 4-6 cm. wide, the margins scabrous-serrulate. Inflorescence a terminal, dense, plumose, racemose panicle to 1 m. long, the branches drooping. Spikelets unisexual, usually several-flowered, the naked rachilla disarticulating above the glumes, glumes and lemmas quite different in staminate and pistillate spikelets. Staminate spikelets: 1-3-flowered, 4 mm. long; glumes somewhat unequal, 2.5 and 3 mm. long, hyaline, acute but not produced; lemmas to 3.5 mm. long, glabrous, acute but not produced. Pistillate spikelets: 2-3-flowered, 6 mm. long; glumes very unequal, the first 3-4 mm. long, acute, the second 9-10 mm. long, long-attenuate and produced into a pseudo-awn much exceeding the spikelet; lemmas to 5 mm. long, long-attenuate into a pseudo-awn about 4-5 mm. long, densely long-villous; stigmas black-purple. LA PAZ: NOR YUNGAS: Coripata, *Hitchcock* 22683 (Hitchcock); SUR YUNGAS: Covendo, *White* (M. E.) 901 (US), 984 (US).

18. **Melica** L.

See Papp in Fedde, Rep. Sp. Nov. **25:** 97-160 (1928).

Straggling perennials, culms up to 1 m. high, usually shorter. Leaf-sheaths scabrous, the blades flat or involute, occasionally equaling or even exceeding the inflorescence. Inflorescence a rather narrow, terminal, racemose panicle, the branches distant, spreading. Spikelets 1-4-flowered, the lowest 1-2 perfect, the upper 2-3 sterile and aggregated into a clavate mass, the rachilla glabrous or minutely puberulent, disarticulating above the glumes, the spikelet falling as a unit; lemmas densely puberulent or tuberculate-scabridulous.

a. Lowest lemma with large thick hairs on lateral and submarginal nerves. ..... 1. *M. violacea.*

a. Lowest lemma without large thick hairs.

b. Spikelets to 1 cm. long, perfect florets 1-2; leaf-blades flat, 2-6 mm. wide. ..... 2. *M. scabra.*

b. Spikelets to 7 mm. long, 1 perfect floret; leaf-blades narrow, involute. ..... 3. *M. adhaerens.*

1. **Melica violacea** Cav. Ic. **5:** 47, t. 472 (1799). Spikelet about 7 mm. long, with 1 perfect floret. First glume suborbicular, about 7 mm. long, prominently nerved on the lower portion, the hyaline margins broad; second glume much narrower, about as long, densely scabridulous-puberulent. Fertile lemmas 5-6 mm. long, many-nerved, densely puberulent. Palea as long as lemma, bicarinate, the keels ciliolate, the inter-carinal area scabridulous-puberulent. SANTA CRUZ: VALLEGRANDE: Comarapa, 3000 m., *Steinbach* 8461 (GH).

2. **M. scabra** HBK. Nov. Gen. & Spec. **1:** 164 (1816). *M. scabra* var. *glabra* Papp in Fedde, Rep. Sp. Nov. **25:** 145 (1928). Spikelets to 6-10 mm. long, with 1-2 perfect florets. Glumes unequal, more or less hyaline, especially on the margin, 1-nerved, the first 8 mm. long, the second to 10 mm. Fertile lemmas to 8 mm. long, the upper portion hyaline, the lower part many-nerved, the nerves and intercostal areas densely tuberculate-scabridulous. Palea to 5 mm. long, bicarinate, the keels ciliate, the back usually puberulent. LA PAZ: LARECAJA: Sorata, *Mandon* 1343 (US).

3. **M. adhaerens** Hack. in Fedde, Rep. Sp. Nov. **6:** 158 (1908). *M. adhaerens* var. *tenuis* (Papp) Papp in Notizbl. **10:** 412 (1928). *M. Mandonii* Papp in Notizbl. **10:** 356 (1928). Spikelet about 7 mm. long, with 1 perfect floret. First glume 7 mm. long, broadest above the middle, abruptly short-acute, 1-nerved; second glume as long, much narrower, the nerves obscure, lower half puberulent-scabrid. Fertile lemma about 6 mm. long, apex hyaline, lower half many-nerved, densely tuberculate-scabrid. Palea about 4 mm. long, bicarinate, the keels ciliolate, the back densely puberulent. LA PAZ: MURILLO: Potopoto, Río Chuquiaguillo, 3700 m., *Mandon* 1357 (GH; type-number of *M. Mandonii*); La Paz, 3300 m., *Bang* 30 (GH), 3500 m., *Buchtien* 505

(GH), 3700 m., *Hitchcock* 22565 (GH). COCHABAMBA: MIZQUE: Vila-vila, 2500 m., *Eyerdam* 24983 (GH).

19. **Anthochloa** Nees

See Matthei in Gayana, Bot. no. 8: 11-15 (1963).

Anthochloa lepidula Nees & Mey. in Meyen, Reise, **2**: 14 (1835). *A. rupestris* Remy in Ann. Sci. Nat. (Ser. 3) **6**: 347 (1846). Densely caespitose dwarf perennial, less than 10 cm. high. Leaf-blades 0.5-1.5 mm. wide, somewhat scabridulous, often exceeding the inflorescence. Inflorescence a greatly reduced racemose panicle, more or less capitate in appearance, sometimes only 1 spikelet to a panicle-branch. Spikelets about 8 mm. long, with 4-6 perfect florets, the naked rachilla disarticulating above the glumes. Glumes hyaline, the apex sometimes erose, 2 and 2.5 mm. long. Lemmas hyaline, scarious, 4 mm. long and 5 mm. wide, deeply bifid. Palea shorter than lemma, hyaline, deeply 2-3-cleft almost to the base. LA PAZ: LARECAJA: vic. Sorata; Lacatia ad La Apacheta, 4500-5000 m., *Mandon* 1372 (GH).

20. **Orthoclada** Beauv.

Orthoclada laxa (Rich.) Beauv. ex Nees, Agrost. Bras. 522 (1829). Perennial, stoloniferous, the culms up to 1 m. high. Leaf-sheaths puberulous, the lance-ovate blades to 15 cm. long, and 2.5 cm. wide, scabridulous above, the base long-petiolately attenuate, glabrous. Inflorescence a terminal racemose panicle, the slender branches ultimately divergent, erect-appressed before maturity. Spikelets usually solitary, disarticulating below the glumes, usually with 1 perfect floret but often 2-flowered, fertile floret below sterile, 6-10 mm. long, the rachilla pubescent. Glumes unequal, to 4 and 5 mm. long, the first 3-nerved, main nerve scabrid, the second 5-nerved, all nerves scabrid on upper portion at least. Lemma to 7 mm. long, obscurely 5-nerved, scabrid-puberulent on upper portion. Palea about 4.5 mm., bicarinate, the keels ciliolate. SANTA CRUZ: ICHILO: Río Vibora, 350 m., *Steinbach* 7576 (GH); SARA: Río Surutú, 400 m., *Steinbach* 7294 (GH).

21. **Zeugites** Schreb.

Zeugites mexicana (Kunth) Trin. ex Steud. Nomencl. (ed. 2) **2**: 798 (1841). *Z. mexicana* var. *glandulosa* Hack. in Fedde, Rep. Sp. Nov. **6**: 758 (1908). A slender much-branched perennial, the wiry culms usually less than 30 cm. high. Leaf-sheaths sparsely pilose, especially at the apex; leaf-blades long-petiolate, the petiole pubescent at base and apex, the blades broadly lance-ovate, acute, up to 3 cm. long and 1.5 cm. wide. Inflorescence a few-branched, few-flowered, open, racemose panicle up to 5 cm. long. Spikelets few-flowered (2-3), the lowest floret perfect, the upper florets staminate and decidedly distant from the lowermost, the naked rachilla disarticulating above the glumes, the spikelet falling as a unit; spikelet to 6 mm. long. Glumes

somewhat unequal, 1.5 and 2 mm. long, herbaceous, often purple-tipped, the second 5-nerved, the 3 central nerves connected by conspicuous transverse veinlets, both glumes with 2-3 very short teeth at apex, and with slightly ciliolate margins. Lemmas 3 mm. long, 7-nerved, with a very short central apical tooth. Palea as long as the lemma, strongly bicarinate in the upper portion. LA PAZ: NOR YUNGAS: Coripata, *Bang* 2131 (GH); Bella Vista, *Hitchcock* 22751 (GH). COCHABAMBA: CHAPARE: Incachaca, 2600 m., *Steinbach* 9872 (GH).

22. **Triodia** R. Br.

Triodia avenacea HBK. Nov. Gen. & Sp. 1: 156 (1816). Caespitose dwarf perennial, from 3-10 (-20) cm. high. Leaf-sheaths sparsely pilose, the flat blades to 3 cm. long, 2 mm. wide, falcate, pilose above and beneath (at least when young), obtuse, shortly mucronate. Inflorescence a short (1-4 cm.), dense, terminal, racemose panicle, the rachis villous. Spikelets about 6 mm. long, with up to 5 perfect florets, the naked rachilla disarticulating above the glumes. Glumes unequal, the first 5 mm. long, with a ciliolate keel, the second, 7-8 mm. long, exceeding the spikelet, the keel scabridulous. Lowest lemma about 4 mm. long, the lemmas decreasing in size upwards on the rachilla, deeply bifid, with a scabridulous 4 mm. awn arising from the base of the sinus, the 2 lobes shortly 2-toothed, the rounded back densely villous at base, ciliate, the hairs increasing in length toward the apex. Palea much shorter than the lemma, bicarinate, the keels ciliate, long-villous between the keels and the margin. POTOSÍ: CERCADO: Potosí, 4000 m., *Cárdenas* 204 (GH).

23. **Pappophorum** Schreb.

Caespitose perennials, the culms 2-5 dm. high. Leaves pubescent or pilose on sheaths and blades, the blades narrow, 1-2 mm. wide, not equaling the inflorescence or sometimes exceeding it. Inflorescence a terminal, narrow, racemose panicle, spicate in appearance. Spikelets 1-3-flowered, the lowest floret perfect, the rest sterile, the puberulent rachilla disarticulating above the thin-textured glumes; lemmas firm or indurate, the apex dissected into numerous awns.

Panicle lead-colored; awns plumose, 3.5-5 mm. long. .... 1. *P. Wrightii.*
Panicle light to purplish; awns scabrid, 0.5-1 cm. long. ..... 2. *P. mucronulatum.*

1. **Pappophorum Wrightii** S. Wats. in Proc. Amer. Acad. 18: 178 (1883). Panicle 2-5 cm. long. Spikelets about 5 mm. long (including the awns). Glumes pilose, the first to 4 mm. long, the second to 5 mm. Lemmas about 1.5-2 mm. long, the awns about 3.5 mm., strongly nerved, short-pilose. Palea as long as the lemma, bicarinate, the keels ciliolate, sparsely pubescent between keels and margins. TARIJA: CERCADO: Tarija, *Fries* 1221 (US).

2. **P. mucronulatum** Nees, Agrost. Bras. 412 (1829). Panicle 5-10

cm. long. Spikelets about 1.4 cm. long (including the awns). Glumes glabrous, short-awned (awns 1-1.5 mm.), 5 and 6 mm. long. Lemmas about 3.5 mm. long, the awns about 1 cm. long, villous at base externally, internally pubescent, at least at the apex, the nerves not visible on the exterior. Palea as long as the lemma, bicarinate, the keels ciliolate. COCHABAMBA: CERCADO: Cochabamba, *Holway* 367 (US). TARIJA: CERCADO: Tarija, *Fries* 1099 (US).

24. **Agropyron** Gaertn.

Perennial, more or less erect, the culms to 1-2 m. high, basally decumbent, sometimes stoloniferous. Leaf-sheaths usually glabrous but occasionally puberulent; leaf-blades to 12 cm. long and 4 mm. wide, much shorter than the inflorescence, usually glabrous, sometimes puberulent, long-acute. Inflorescence a single spike or raceme, or slightly paniculate (rarely so), the spikelets sessile, subsessile or with a 1 mm. pedicel, sometimes rather unilateral in arrangement. Spikelets solitary, occasionally paired, the rachilla disarticulating above the glumes, few- to several-flowered; glumes awnless, or very short-awned; lemmas awnless or short-awned.

Glumes at least 1 cm. long, with 4-6 prominent nerves; lemmas awnless or shortly mucronulate (mucro 0.75 mm.). .... 1. *A. attenuatum.*
Glumes less than 1 cm. long, nerves inconspicuous; lemmas with an awn to 7-8 mm. long. ..... 2. *A. breviaristatum.*

1. **Agropyron attenuatum** (HBK.) Roem. & Schult. Syst. Veg. **2:** 751 (1817). Spike 7-17 cm. long. Spikelet about 2 cm. long, several-flowered (up to 6), the uppermost a sterile lemma, the 1 below it apparently staminate. Glumes subequal, 1-1.2 cm. long, obtuse. Lowest lemmas 1-1.2 cm. long, lowest shortly tridentate, 5-nerved, its palea 9 mm. long, 2-nerved, the nerves markedly ciliolate. Upper lemmas equal to or slightly shorter than the lowest, the uppermost much shorter. LA PAZ: MURILLO: La Paz, 3700 m., *Buchtien* 8532 (GH); NOR YUNGAS: Pongo, 3640 m., *Hitchcock* 22766 (GH).

2. **A. breviaristatum** Hitchc. in Contrib. U.S. Nat. Herb. **24:** 353 (1927). Spikes 10-20 cm. long. Spikelets 1-1.5 cm. long, 3-5-flowered. Glumes subequal, 7-10 mm. long, acuminate, scabridulous, especially on the nerves. Lemmas 8-9 mm. long, scabrid, awned. LA PAZ: OMASUYOS: Isla del Sol, *Asplund* 6461 (Hitchcock).

25. **Elymus** L.

Elymus angulatus Presl, Rel. Haenk. **1:** 264 (1830). Perennial, culms spreading at base but erect, to 1 m. high, the plants glabrous. Leaf-blades much shorter than the inflorescence, to 6 mm. wide, acute, scabridulous beneath. Inflorescence a terminal spike, with 2 sessile spikelets at a node (rarely solitary ?), the spike, to 15 cm. long. Spikelets about 1.3 cm. long (excluding the awns), up to 6-flowered, always with more than 1 perfect floret, disarticulation above the

glumes; glumes equal or subequal, about 1 cm. long, awn 3 mm. long, apex ciliolate, mid-nerve and awn scabridulous to scabrid, at least on the upper portion of the glume; lemmas distinctly rounded, subterete, about 1 cm. long, awns 4-5 mm. long, scabridulous near the apex, palea nearly as long as the lemma, bicarinate, the keels densely scabrid-ciliate on the upper half; uppermost floret a rudiment, the one below it neuter or possibly sometimes staminate. POTOSÍ: SUR CHICHAS: Oploca, *Hitchcock* 22892 (GH).

26. Hordeum L.

Perennials, erect or spreading, or decumbent, sometimes caespitose, usually 2-4 dm. high. Leaves glabrous, the short flat blades to 3 mm. wide, acute, scabridulous beneath, never equaling nor exceeding the inflorescence. Inflorescence a short terminal spike, less than 10 cm. long, with 3 spikelets at a node, the rachis jointed and disarticulating. Spikelets 1-flowered, glumes present, the rachilla disarticulating above the glumes, the lemmas acuminate or shortly or long-awned, the palea bicarinate; central spikelet sessile, the 2 laterals somewhat pedicellate and reduced to slender setose glumes.

Lemmas awnless or very shortly awned; glumes of fertile floret with awns 4 mm. long; rachilla obviously prolonged behind the palea. .... 1. *H. muticum.*

Lemma with a 6 mm. awn; glumes of fertile floret with awns 1 cm. long; rachilla only slightly or not at all prolonged behind the palea. .... 2. *H. halophilum.*

1.**Hordeum muticum** Presl, Rel. Haenk. 1: 327 (1830). Spikelet, excluding awns, about 6 mm. long. Glumes reduced virtually to scabridulous awns 4 mm. long. Lemma about 5 mm. long, seldom short-awned. Palea less than 5 mm. long, bicarinate. Sterile glumes reduced to awns 4-5 mm. long. LA PAZ: OMASUYOS: vic. Achacache, 3950 m., *Mandon* 1379 (GH); MURILLO: La Paz, 3750 m., *Buchtien* 55 (GH), *Bang* 179 (GH). POTOSÍ: CERCADO: Potosí, 4000 m., *Cárdenas* 207 (GH). TARIJA: AVILES: Puna Patanca, 3700 m., *Fiebrig* 3193 (GH).

Hordeum nodosum L. Sp. Pl. (ed. 2) 126 (1762) has been ascribed to Bolivia by Hitchcock on the basis of a collection made by Pearce. I have seen no South American material of this species. It is apparently like *H. muticum* but with longer awns.

2. **H. halophilum** Griseb. in Goett. Abh. 19: 249 (1874). Spikelet, excluding awns, about 5 mm. long. Glumes of fertile floret reduced to awns 1 cm. long. Lemma 5 mm. long, with a 6 mm. awn. Palea about 6 mm. long, bicarinate, the apex bidentate. Sterile glumes reduced to awns over 1 cm. long. LA PAZ: MURILLO: La Paz, 3700 m., *Buchtien* 506 (GH).

27. **Lolium** L.

Annual or perennial, 2-8 dm. to 1 m. high. Leaf-blades long, often nearly equaling the inflorescence, to 1 cm. wide, scabridulous beneath. Inflorescence a terminal spike, 2-25 cm. long, the sessile spikelets solitary at the nodes and placed edgeways to the rachis. Spikelets several-flowered, first glume absent from all but the uppermost spikelet, rachilla disarticulating above the glumes, lemmas dorsally rounded, awned or awnless.

a. Glume to 2 cm. long, usually as long as, often exceeding, the spikelet. ..... 1. *L. temulentum.*

a. Glume less than 1 cm. long, usually much shorter than the spikelet.

b. Lemmas awnless. ..... 2. *L. perenne.*

b. Lemmas awned. ..... 3. *L. multiflorum.*

1. **Lolium temulentum** L. Sp. Pl. 83 (1753). Annual. Spikelet 1.5-2 cm. long, with up to 7-8 florets. Second glume to 2 cm. long, almost always longer than the rest of the spikelet, very firm-textured. Lemmas very firm, about 8 mm. long, obscurely nerved, the apex with 2 blunt hyaline teeth and a very short scabrid awn rising from between the bases of the teeth, or the uppermost lemmas sometimes very long-awned. Palea firm-textured, nearly as long as the lemma, the upper margins ciliolate. LA PAZ: LARECAJA: vic. Sorata; Cicirca, Munaypata, *Mandon* 1376 (GH).

1a. **L. temulentum** var. **arvense** (With.) Bab. Brit. Bot. 377 (1843). Differs by awnless lemmas. No material has been seen.

2. **L. perenne** L. Sp. Pl. 83 (1753). Perennial. Spikelet about 1 cm. long, occasionally to 1.5 cm., with up to 10 florets. Second glume about 5 mm. long, more or less obtuse. Lowermost lemmas about 5 mm. long, decreasing in length upward on the spikelet. Palea as long as the lemma, the margins densely and shortly scabrid-ciliate. LA PAZ: MURILLO: La Paz, 3700 m., *Buchtien* 4487 (GH).

3. **L. multiflorum** Lam. Fl. Franç. **3:** 621 (1778). Perennial. Spikelet (excluding awns) to 1.5 cm. long, with up to 10 florets. Second glume about 1 cm. long, rather obtuse. Lemmas to 7 mm. long, the apex bidentate, awns to 6 mm. long. Palea as long as the lemma, the margins ciliate. COCHABAMBA: CERCADO: Valle de Cercado, 2700 m., *Steinbach* 9549 (GH).

28. **Pariana** Aubl.

See Tutin in Journ. Linn. Soc. Bot. **50:** 337-362 (1936).

Perennial, from a creeping scaly rootstock. Leaves few, reduced to sheaths on fertile culms (except in no. 1), leaf-sheaths puberulent to glabrous, the orifice often fimbriate; blades broad, lanceolate to ovate, pubescent to glabrous, often scabrid beneath. Inflorescence condensed, spicate, male spikelets 1-flowered, pedicellate, in whorls of 4-6, usually 5, pedicels often fused marginally, a solitary 1-flowered

female spikelet sessile within the whorl; rachis disarticulating between the whorls. Glumes lateral, flanking the lemma, 1-3 nerved. Lemma ovate to oblong, coriaceous, usually 3-nerved. Palea shorter and thinner than the lemma.

a. Leaf-sheaths without fimbriae at apex; lemmas less than 6 mm. long.
   b. Glumes 2-3-nerved; terminal spikelet pistillate. ..... 1. *P. bicolor.*
   b. Glumes 1-nerved; terminal spikelet sterile. ..... 2. *P. gracilis.*
a. Leaf-sheaths fimbriate at apex; lemmas about 7 mm. long. ..... 3. *P. Swallenii.*

1. **Pariana bicolor** Tutin in Journ. Linn. Soc. Bot. **50:** 355 (1936). Sterile culms to 8 dm. high. Leaf-sheaths imbricate, glabrous, the efimbriate blades to 25 cm. long and 5 cm. wide, oblong to ovate, acuminate, glaucous and scabridulous beneath, glabrous above. Fertile culms to 4.5 dm. high, leaves reduced to sheaths or the uppermost sheath sometimes with a rudimentary blade, sheaths puberulent, the orifice ciliate with short, stiff, white hairs. Inflorescence 5-9 cm. long. Male spikelets in whorls of five, pedicels 2-3 mm. long, puberulous, basally heavily bearded. Glumes 2-2.5 mm. long, acute to acuminate, glabrous or ciliolate, 2-3-nerved, the nerves confluent near the apex. Lemma 3.5-4.5 mm. long, lance-elliptic, acute, midrib prominent, glabrous. Female spikelet: glumes obtuse, 6 mm. long, lemma and palea 6 mm. long. LA PAZ: LARECAJA: Mapiri, 1300 m., *Rusby* 232 (US); San Carlos, Mapiri, 850 m., *Buchtien* 458 (GH; type-number); CAUPOLICÁN: San Buena Ventura, 500 m., *Cárdenas* (M. E.) 1889 (US).

2. **P. gracilis** Doell in Mart. Fl. Bras. 2(2): 337 (1877). Sterile culms leafy, sheaths imbricate, fimbriae lacking. Leaf-blades oblong-lanceolate, to 15 cm. long and 2.5 cm. wide, acuminate. Fertile culms leafless, the inflorescence slender. Male spikelets hardly imbricate, the pedicels to 3 mm. long, pubescent. Glumes to 3 mm. long, acute, 1-nerved. Lemma to 4.5 mm. long, oblong-ovate, acute, glabrous, sometimes red and purplish, the nerves obscure. LA PAZ: CAUPOLICÁN: Mojos, *d'Orbigny* 147 (Tutin).

No material has been available to me and this description has been derived from that of Tutin.

3. **P. Swallenii** R. C. Foster, spec. nov. Culmi steriles ad 6.5 dm., foliati, nodi dense breveque hispidi, vaginae puberulae vel glabrae, ad orem fimbriatae. Laminae (2) inaequales, late ovatae, acutae, ad 30 cm. longae et 10 cm. latae, supra glabrae, subtus glaucae et plus minusve scabridulae. Culmi fertiles ad 2.5 dm., efoliati, pubescentes, vaginis imbricatis glabris vel subpuberulis obtecti. Inflorescentia subcrassa, ad 13 cm. longa. Spiculae masculinae 5 in verticillo, pedicelli ad 3 mm. longi, puberuli, basi barbati, plus minusve coaliti. Glumae ad 4-5 mm. longae, 3-nervatae, acutae vel acuminatae, vel subsetaceae, ciliatae, minute papillatae. Lemma 7 mm. longum, ob-

longum, obtusum vel subacutum, glabrum, 5-nervatum, nervis paucis connectentibus prope apicem. Spicula feminea; gluma prima ca. 7-8 mm. longa, 1-nervata, ciliata, puberula; gluma altera breviora, ciliata, glabra, 1-nervata; lemma ca. 6 mm. longum. COCHABAMBA: CHAPARE: Puerto Polonia, Río Coni, 14 km. east of San Antonio, 395 m., Oct., *Cárdenas & Cutler* 7358 (Typus, in Herb. Gray.).

Since Mr. J. R. Swallen has described a number of new South American species in this genus, it is fitting that this apparent novelty should be named for him.

Pariana lunata Nees, Agrost. Bras. 295 (1829), was ascribed to Bolivia by Hitchcock in his treatment of Andean grasses. The only specimen he cited, however, was sterile. The later monographer, Tutin, saw no Bolivian material, so that its presence in Bolivia is still problematical. Should fertile material be found, it can easily be distinguished from the three other Bolivian species by the fact that the fertile culms bear well-developed leaves rather than, at most, rudimentary leaf-blades.

Pariana zingiberina Doell in Mart. Fl. Bras. 2(2): 337 (1877) was also ascribed to Bolivia by Hitchcock. All the material cited by him was later cited by Tutin under the new species, *P. bicolor* Tutin. No Bolivian material was cited by Tutin for *P. zingiberina*, and it seems almost certain that it is not a member of the Bolivian flora.

To be continued

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STUDIES IN THE FLORA OF BOLIVIA — IV

Robert C. Foster

Continued from Vol. 68, No. 774

29. **Dissanthelium** Trin.

Annual or perennial, the plants seldom over 10 cm. high, caespitose. Leaves glabrous, the blades flat or involute. Inflorescence a short, terminal, racemose panicle, spicate in appearance. Spikelets mostly 2-flowered, occasionally 3-flowered or 1-flowered, the naked rachilla disarticulating above the glumes and prolonged beyond the uppermost floret; glumes equal, longer than the lemmas; glumes and lemmas awnless.

a. Glumes 3 (-3.5) mm. long.
  b. Lemma puberulent, obtuse, with a central mucro. ..... 1. *D. macusaniense.*
  b. Lemma scabridulous, obtuse, but not toothed. ..... 2. *D. calycinum.*

a. Glumes 5 mm. long.
  c. Inflorescence 5-7 mm. broad, compact; spikelets numerous. ..... 3. *D. peruvianum.*
  c. Inflorescence less than 5 mm. broad, lax, spikelets few. ..... 4. *D. Trollii.*

1. **Dissanthelium macusaniense** (Krause) Foster and Smith in Phytologia, **12:** 249 (1965). *D. minimum* Pilger in Engler, Bot. Jahrb. **56,** Beibl. 123: 28 (1920). Annual, the leaf-blades flat. Inflorescence 1-2 cm. long, more or less oblong, the rachis, branches and pedicels only faintly scabridulous. Spikelets mostly 2-flowered. Lemma about 2.5 mm. long. Potosí: cercado: Potosí, 4000 m., *Cárdenas* 198 (GH).

2. **D. calycinum** (Presl) Hitchc. in Journ. Wash. Acad. Sci. **13:** 224 (1923). Perennial. Inflorescence to 3 cm. long, oval, rachis, branches and pedicels puberulent-scabridulous. Spikelets 2-flowered. Lemma about 2.5 mm. long. Without locality: *Bang* 1873 (GH).

3. **D. peruvianum** (Nees & Meyen) Pilger in Engler, Bot. Jahrb. **37:**

378 (1906). Perennial. Apparently differs from *D. calycinum* primarily in having longer glumes and in spikelets frequently 1-flowered. LA PAZ: LARECAJA: Sorata, *Mandon* 1345 (GH).

4. **D. Trollii** Pilger in Notizbl. **11**: 778 (1933). Perennial, about 5 cm. tall. Leaves with flat pungent blades to 4.5 cm. long (usually shorter) and 2 mm. wide. Inflorescence narrow, about 2 cm. long (2.5 cm. on the type), the rachis glabrous to scabridulous, pedicels scabridulous, sometimes almost glabrous, or scabrid on the margins and angles. Spikelet to 5 mm. long, 2-flowered. Glumes as long as the spikelet, acute to very acute. Lemmas 4 mm. long, hyaline. Palea hyaline, nearly as long as the lemma, bicarinate, slightly bidentate, the teeth obtuse (when flattened). LA PAZ: MURILLO: Chacaltaya, 4800 m., *Buchtien* 1197 (US); La Cumbre, 5000 m., *Tate* 10 (US), *Parodi* 10042a (US); La Union, 4800 m., *Troll* 1966 (US; type-number).

30. **Koeleria** Pers.

Koeleria cristata (L.) Pers. Synops. Pl. **1**: 97 (1805). *K. gracilis* subsp. *boliviensis* (Domin) Domin in Biblioth. Bot. **65**: 237 (1907). *K. pseudocristata* var. *andicola* Domin in Fedde, Rep. Sp. Nov. **2**: 94 (1906). Perennial, to 5 dm. high, the culms pubescent. Leaves mostly basal, the sheaths from nearly glabrous to pubescent, the flat blades pubescent, at least when young. Inflorescence a dense, terminal, racemose panicle, to 10 cm. long, interrupted at the base, the rachis, branches and pedicels pubescent. Spikelets 2-4-flowered, about 6 mm. long, the rachilla villous, disarticulating above the glumes. First glume 4.5 mm. long, 1-nerved, scabridulous on the nerve; second glume 5 mm. long, 3-nerved, the keel scabridulous. Lowest lemmas 5 mm. long, bidentate, with a 4 mm. awn arising from the base of the sinus, the keel and awn scabridulous. Palea about 4 mm. long, bidentate, the keels ciliolate. LA PAZ: NOR YUNGAS: Pongo, 3640 m., *Hitchcock* 22767 (GH).

With the form described here, there is also to be found one in which leaves and culms are more densely pubescent and the lemmas are awnless or, at most, shortly mucronate. Both forms are found on the Gray Herbarium sheet of *Hitchcock* 22767.

31. **Trisetum** Pers.

Perennials, 1-5 dm. high, rarely to 1 m., the leaves and culms glabrous, the leaf-blades involute or flat and sometimes scabridulous. Inflorescence a terminal, dense, racemose panicle, spicate in appearance, interrupted at the base, 2-15 cm. long. Spikelets 2-3-flowered, unilateral, fertile florets below the sterile, disarticulating above the unequal glumes; lemmas awned.

Glumes to 1 cm. long, acuminate, lemmas to 1.5 cm. long, rachilla glabrous. ..... 1. *T. floribundum.*
Glumes to 5 mm. long, acute, lemmas about 5 mm. long or less, rachilla villous. ..... 2. *T. spicatum.*

1. **Trisetum floribundum** Pilger in Engler, Bot. Jahrb. **37:** 505 (1906). *Dielsiochloa floribunda* of the Catalogue. *Bromus Mandonianus* of the Catalogue. To 3 dm. high, leaf-blades involute. Panicle to 6 cm. long, more or less oval, branches and pedicels scabridulous. Spikelets (excluding awns) about 1.3 cm. long. First glume to 7 mm. long, second to 1 cm. Lemmas deeply bidentate, the narrow teeth resembling awns, the true awn to 1.5 cm. long. Palea to 1 cm. long, bidentate, the keels ciliolate. LA PAZ: LARECAJA: vic. Sorata; ad lacum Turiguana, 4500 m., *Mandon* 1371 (GH; type-number of *Bromus Mandonianus*).

2. **T. spicatum** (L.) Richt. Pl. Eur. **1:** 59 (1890). *T. oreophilum* Louis-Marie in Rhodora, **30:** 221 (1928). To 3 dm. high, rarely to 1 m., leaf-blades flat, leaves chiefly basal. Panicle narrow, to 15 cm. long, rachis, branches and pedicels pubescent. Glumes 3.5 and 4 mm. long, the keels scabridulous. Lemmas pubescent to villous, bidentate, the teeth not produced as pseudo-awns, the true awn about 3 mm. long. LA PAZ: MURILLO: La Paz, 3700 m., *Buchtien* 8540 (GH).

32. **Deschampsia** Beauv.

See Parodi in Darwiniana, 8: 415-475 (1949).

Perennial. Leaf-blades flat or folded. Inflorescence a dense to open racemose panicle, sometimes interrupted below. Spikelets 2-flowered, the villous rachilla prolonged beyond the upper floret, disarticulation above the glumes. Glumes equal or subequal. Lemmas thin to hyaline, the apex obtuse, 2-4-toothed, bearing a dorsal awn at or below the middle.

Panicle dense, the short branches appressed, interrupted below; awn much exceeding the lemma. .....1. *D. conferta.*
Panicle lax, the branches long, not appressed; awn equaling or slightly exceeding the lemma. ..... 2. *D. caespitosa.*

1. **Deschampsia conferta** (Pilger) Valencia in Revist. Argent. Agron. 8: 127 (1941). *Aira conferta* of the Catalogue. Plant to 10 dm. tall, usually shorter. Leaf-blades linear, flat, scabrid above and beneath, to 3 mm. wide. Panicle dense, to 20 cm. long, rachis glabrous or slightly scabridulous on the upper portion, branches and pedicels scabridulous. Spikelets to 5 mm. long (excluding the awns). Glumes to 5 mm. long, acute, the margins erosulous near the apex, the keel scabridulous. Lemmas about 3 mm. long, deeply bidentate, the teeth more or less acute; awn twisted for 1.5-2 mm., geniculate, scabrid, the whole to 5 mm. long. COCHABAMBA: CERCADO: north of Cochabamba, *Hitchcock* 22814 (US).

2. **D. caespitosa** (L.) Beauv. Ess. Agrost. 91, 149, 160 (1812). Plant to 1.2 m. tall, densely caespitose. Leaf-sheaths glabrous; blades linear, to 4 mm. wide, flat or folded, scabrid above. Inflorescence an open panicle, to 3 dm. long, the branches rather long, branches and pedicels scabridulous. Spikelets to 4 mm. long, the rachilla sometimes bearing a reduced floret at the apex. Glumes subequal, about 4 mm. long, obtuse and erose to acute, often purple-tinged, thin, obscurely nerved. Lemma 3 mm. long, hyaline, the apex usually several-toothed, the awn equaling or somewhat exceeding the lemma, but not markedly so; palea narrow, slightly shorter than the lemma.

No Bolivian material has been seen. The species is included on the authority of Parodi, l. c., who cites a specimen (collector unknown) from the vicinity of the city of Santa Cruz de la Sierra.

33. **Avena** L.

Annuals up to 7.5 dm. high, the leaf-blades flat, to 4-8 mm. wide, scabrid, occasionally pilose. Panicle lax, the branches distant, racemose, to 25 cm. long, rachis and branches glabrous, the pedicels sometimes puberulous-scabridulous. Spikelets 2-3-flowered, the rachilla villous, disarticulating above the nearly equal, many-nerved, papery glumes; lemmas bidentate, villous on the lower portion at least, awned, the awn arising from mid-lemma or below.

Pedicels spreading, glumes to 2.5 cm. long, lemmas about 2 cm. long, acute. ..... 1. *A. fatua.*

Pedicels flexuous, glumes to 2 cm. long, lemmas about 1.5 cm. long, the teeth setaceous. ..... 2. *A. barbata.*

1. **Avena fatua** L. Sp. Pl. 80 (1753). Spikelets (excluding awns) about 2.5 cm. long. Awn to 3.5 cm. long. COCHABAMBA: CERCADO: Cochabamba, *Hitchcock* 22836 (Hitchcock).

2. **A. barbata** Brot. Fl. Lusit. **1:** 108 (1804). Spikelets (excluding awns) about 1.5-2 cm. long. Awns to 3 cm. long. LA PAZ: MURILLO: Palca, *Pflanz* 2541 (Hitchcock).

34. **Holcus** L.

Holcus lanatus L. Sp. Pl. 1048 (1753). Perennial, to 1 m. high. Leaf-sheaths, blades and culms pubescent, the blades flat, about equal to the base of the mature inflorescence, to 6 mm. wide. Inflorescence a terminal, racemose, dense panicle to 10 cm. long, the rachis, branches and pedicels pubescent. Spikelets 2-flowered, the lower floret perfect, the upper staminate, 1 spikelet sessile, 1 pedicellate, the rachilla glabrous, disarticulation above the equal glumes, these to 3.5 mm. long, exceeding the florets, the first obscurely 3-nerved, the keel and upper margins ciliate, the second 3-nerved, broader, keel and margins ciliate,

both glumes mucronulate. Pistillate lemmas 2 mm. long, nerveless, awnless, obtuse, shining, the palea as long as its lemma, the keels ciliolate. Staminate lemmas 2 mm. long, nerveless, with a 1.5 mm. stout hooked awn at apex, the palea shorter than its lemma, the keels ciliolate. LA PAZ: MURILLO: La Paz, 3300 m., *Bang* 155 (GH). COCHABAMBA: TOTORA: Pocona, 2500 m., *Steinbach* 8671 (GH).

35. **Danthonia** Lam. & DC.

Danthonia cirrhata Hack. & Arech. in Arech. Gram. Uruguay, 307 (1894). Perennial, to 6 dm. tall, nodes glabrous. Leaves sparsely papillate-hirsute on sheaths and blades, the narrow blades involute, seldom equaling the inflorescence. Inflorescence a narrow panicle usually less than 10 cm. long, few-flowered. Spikelets several-flowered, the uppermost floret sterile; disarticulation above the glumes; axis glabrous to puberulent, the pedicels puberulent and often pilose at the base. First glume to 1.5 cm. long, long-acute, glabrous, 5-nerved, the central nerve prominent, margins thin to hyaline; second glume similar, about 2 mm. shorter. Rachilla long-plumose at the base, hairs to 5 mm. long, white. Fertile lemmas to 6 mm. long, pilose near margin below the middle, deeply bidentate, the teeth produced as pseudo-awns 5 mm. long, a true awn, twisted, to 1 cm. long, arising at base of sinus between teeth. Palea thin, to 4 mm. long, the 2 keels briefly ciliolate. SANTA CRUZ: VALLEGRANDE: Samaipata, *Herzog* 1706, 3012 (Henrard).

36. **Lamprothyrsus** Pilger

Lamprothyrsus Hieronymi (O. Ktze.) Pilger in Engler, Bot. Jahrb. **37**: 58 (1906). *L. Hieronymi* var. *tinctus* Pilger in Engler, Bot. Jahrb. **37**: 59 (1906). Perennial, to 2 m. high, leaf-sheaths glabrous, the blades long, involute, scabrid on the upper surface, often nearly equaling the mature inflorescence, the old sheaths ultimately coiled at base of plant. Inflorescence a terminal, racemose panicle to 30 cm. long, fairly open at maturity, rachis glabrous, branches and pedicels often scabridulous. Spikelets (excluding awns and pseudo-awns) about 7 mm. long, with up to 6 florets, the uppermost reduced, disarticulation above the glumes, rachilla villous. Glumes equal or subequal, to 6 mm. long, transparent, without apparent nerves. Body of lemma 3 mm. long, villous, bidentate, the teeth produced as pseudo-awns to 1.7 cm. long, the true awn from the base of the sinus, geniculate shortly above its base, to 2 cm. long. Palea 3 mm. long, keels ciliate, villous between the keels and the margins. LA PAZ: LARECAJA: vic. Sorata; San Pedro, 2650 m., *Mandon* 1360 (GH). SANTA CRUZ: VALLEGRANDE: Cerro La Negra, 1700 m., *Steinbach* 8171 (GH); SARA: Cerro Hosana, 1000 m., *Steinbach* 3453 (GH). TARIJA: ARCE: Bermejo, 1400 m., *Fiebrig* 2099 (GH; type-number of *L. Hieronymi* var. *tinctus*).

37. **Calamagrostis** Adans.

See Tovar in Mem. Mus. Hist. Nat. Javier Prado, no. 11: 3-88 (1960).

Perennials. Leaves flat or involute. Inflorescence a panicle, often reduced and condensed. Spikelets disarticulating above the glumes, 1-flowered, with the rachilla more or less prolonged as a bristle behind the palea. Glumes usually more or less equal. Lemma usually shorter than the glumes, thinner-textured, with a dorsal awn (1 species awnless), callus more or less pilose or glabrous, the hairs of varying lengths.

a. Lemmas awnless. ..... 3. *C. calderillensis.*
a. Lemmas awned.
  b. Lemmas stipitate below callus.
    c. Panicle very open, not spicate. ..... 2. *C. eminens.*
    c. Panicle dense, spicate.
      d. Panicle elongate, slender; awn geniculate. .... 4. *C. amoena.*
      d. Panicle short, thick; awn straight.
        e. Awn shorter than the lemma. ..... 7. *C. chrysantha.*
        e. Awn exceeding the lemma, mostly by 1 mm. ..... 8. *C. ovata.*
  b. Lemmas sessile below the callus.
    f. Rachilla glabrous or with a tuft of hairs at the apex only.
      g. Rachilla glabrous. ..... 6. *C. rigescens.*
      g. Rachilla with an apical tuft of hairs.
        h. Rachilla 2 mm. long; awn 9 mm. long. ..... 27. *C. longiaristata.*
        h. Rachilla 1 mm. long; awn 6 mm. long. ..... 30. *C. viridiflavescens.*
    f. Rachilla villous.
      i. Awn 2-2.5 mm. long.
        j. Spikelet 3 mm. long. ..... 29. *C. polygama.*
        j. Spikelet 5-8 mm. long.
          k. Spikelet to 5 mm. long. ..... 13. *C. curvula.*
          k. Spikelet to 8 mm. long. ..... 31. *C. spicigera.*
      i. Awn 4 mm. or more in length.
        l. Awn less than, equaling, or only slightly exceeding the lemma.
          m. Inflorescence narrow, dense. ..... 10. *C. cryptolopha.*
          m. Inflorescence lax.
            n. Rachilla 1.5 mm. long, the longest hairs to 1.5 mm. long. ..... 19. *C. tarijensis.*
            n. Rachilla 2-2.5 mm. long, the longest hairs to 4 mm. long. ..... 23. *C. intermedia.*
        l. Awn distinctly exceeding the lemma.
          o. Inflorescence lax, sometimes spreading.

p. Panicle about 1 dm. long. ..... 18. *C. tarmensis.*
p. Panicle 2 dm. or more in length.
q. Lowest branches of panicle naked for 2-5 cm.
r. Spikelets to 7-8 mm. long; rachilla-hairs to 2 mm. long. ..... 1. *C. leiophylla.*
r. Spikelets to 5-6 mm. long; rachilla-hairs to 4 mm. long. ..... 22. *C. Orbignyana.*
q. Lowest branches of panicle spikelet-bearing from nearly the base.
s. Rachilla-hairs to 1.5 mm long. ..... 26. *C. recta.*
s. Rachilla-hairs to 4 mm. long. .... 21. *C. antoniana.*
o. Inflorescence dense, sometimes interrupted, but not spreading.
t. Panicle over 10 cm. long.
u. Spikelets 4 (-4.5) mm. long. .... 5. *C. heterophylla.*
u. Spikelets 6-8 mm. long.
v. Spikelets to 6 mm. long; callus glabrous or nearly so, if a few hairs present, the longest to 0.4 mm. long. ..... 28. *C. densiflora.*
v. Spikelets 8 mm. long; callus somewhat villous, the longest hairs to 1 mm. long. ..... 11. *C. glacialis.*
t. Panicle less than 10 cm. long.
w. Panicle less than 2 cm. long.
x. Inflorescence narrow, spicate. .... 24. *C. minima.*
x. Inflorescence dense, ovoid. ..... 15. *C. curta.*
w. Panicle 2 cm. or more in length.
y. Panicle not interrupted, or only slightly so at the base.
z. Pedicels villous. ..... 12. *C. Jamesonii.*
z. Pedicels scabridulous to pubescent, or nearly glabrous.
aa. Callus densely villous, the longest hairs 1 mm. long. ..... 16. *C. brevifolia.*
aa. Callus sparsely short-villous, the longest hairs 0.5 mm. long. ..... 9. *C. vicunarum.*
y. Panicle obviously much interrupted.
bb. Panicle to 2.5 cm. long. ..... 14. *C. cephalopora.*
bb. Panicle 4-9 cm. long.
cc. Awn to 7 mm. long. ..... 20. *C. Fiebrigii.*
cc. Awn to 4 mm. long.
dd. Rachis, branches and pedicels glabrous. ..... 17. *C. violacea.*
dd. Rachis, branches and pedicels sparsely scabrid. ..... 25. *C. trichophylla.*

1. **Calamagrostis leiophylla** (Wedd.) Hitchc. in Contrib. U. S. Nat. Herb. **24:** 367 (1927). *C. toluccensis* var. *laxiflora* O. Ktze. Rev. Gen. **3**(2): 345 (1898). Caespitose, erect, 0.5-1 m. high. Leaf-sheaths glabrous to scabridulous, ligule less than 1 mm. long; leaf-blades flat to subinvolute, to 2.5-3 mm. wide. Inflorescence to 3 dm. long, narrow but lax, at least the lowermost branches whorled, axis glabrous below to sparsely scabridulous above, the branches, branchlets and pedicels scabrid. Spikelets to 5-8 mm. long. Glumes to 5-8 mm. long, acute, obscurely nerved, the keel prominent, scabrid. Lemma sessile below the callus, about 2 mm. shorter than the glumes, bidentate, scabridulous; callus glabrous to sparsely short-villous, rachilla about 2 mm. long, the longest hairs about 2 mm. long, not quite equaling the lemma; awn geniculate, to 5-6 mm. long, inserted at the middle of the lemma and exceeding it. COCHABAMBA: CERCADO: Cochabamba, *Holway* 379 (US).

2. **C. eminens** (Presl) Steud. Nomencl. (ed. 2) **1:** 250 (1840). *C. elegans* (Wedd.) Henrard in Meded. Rijks Herb. Leiden, no. 40: 61 (1921). *Deyeuxia polystachya* Wedd. in Bull. Soc. Bot. France, **22:** 177, 178 (1875). *C. eminens* var. *tunariensis* O. Ktze. Rev. Gen. **3**(2): 344 (1898). *C. eminens* var. *sordida* O. Ktze. Rev. Gen. **3**(2): 344 (1898). Caespitose, somewhat rhizomatous, stout, to 1 m. high, in damp or wet places. Leaf-sheaths glabrous, ligule to 1.8 cm.; leaf-blades involute, finely scabridulous to glabrous. Inflorescence open, to 3 dm. long, the spikelets glomerulate or subglomerulate at the ends of branches and branchlets, the rachis, whorled branches and pedicels glabrous to scabridulous. Spikelets to 4-5.5 mm. long. Glumes to 4-5.5 mm. long, acute and erosulous to subobtuse, the keel faintly prominent. Lemma distinctly stipitate below the callus, about 1 mm. shorter than the glumes, obtuse or truncate and erosulous at the apex; callus densely villous, with hairs up to 3 mm. long; rachilla about 1.5 mm. long, long-villous, the hairs chiefly basal; awn delicate, straight, equaling or shorter than the lemma, inserted below the middle of the lemma. LA PAZ: LARECAJA: vic. Sorata; Chicani, 3600-3800 m., *Mandon* 1309 (GH), 1310 (GH; co-types of *Deyeuxia elegans*). COCHABAMBA: ARANI: pass, Cordillera de Cochabamba, 4500 m., *Eyerdam* 24850 (GH).

3. **C. calderillensis** Pilger in Engler, Bot. Jahrb. **42:** 72 (1908). Plant to 13 dm. tall. Leaf-sheaths glabrous, ligule about 3 mm. long; leaf-blades flat to somewhat inrolled, to 7 mm. wide, the margins scabrid, otherwise glabrous above and beneath. Inflorescence to 22 cm. long, the rachis, whorled branches and pedicels glabrous. Spikelets to 4 mm. long. Glumes to 4 mm. long, the second glume longer than the first, acute to subobtuse. Lemma as long as the first glume, sessile below the callus, obtuse or truncate; callus glabrous, with an apical ring of short, sparse, fine hairs; rachilla 0.5 mm. long, sparsely villous, the longest hairs less than 1 mm. long, not reaching the middle

of the lemma; awn lacking. TARIJA: CERCADO: Calderillo, 3300 m., *Fiebrig* 3172 (US; type-number).

4. **C. amoena** (Pilger) Pilger in Engler, Bot. Jahrb. **42:** 60 (1908). *C. filifolia* (Wedd.) Pilger in Engler, Bot. Jahrb. **42:** 67 (1908). To 6 dm. high. Leaf-sheaths glabrous, ligule to 3 mm. long; leaf-blades involute, filiform, minutely scabridulous. Inflorescence 6-15 cm. long, somewhat lax, rachis glabrous below, scabrid above, the whorled branches, branchlets and pedicels scabridulous to scabrid. Spikelets to 5-5.5 mm. long. Glumes to 5-5.5 mm. long, long-acute, entire, the faintly prominent midrib keeled and scabridulous above. Lemma shortly stipitate below the callus, as long as the first glume, scabridulous, with 3-4 very slender, short, apical teeth; callus villous at the apex, the longest hairs 1 mm. long; rachilla to 2 mm. long, the upper portion bristle-like, moderately villous, the longest hairs to 1.5 mm. long, reaching 2/3 the length of the lemma; awn geniculate, to 4.5 mm. long, much exceeding the lemma, the base twisted, the upper portion straight, inserted well below the middle of the lemma. LA PAZ: LARECAJA: vic. Sorata; Marcamocreani, 3500-3600 m., *Mandon* 1306 (GH); NOR YUNGAS: Milluguaya, 2700-3900 m., *Mandon* 1301 (GH); MURILLO: Talca Chuquiaguilla, *Bang* 805 (GH; type-number).

5. **C. heterophylla** (Wedd.) Pilger in Engler, Bot. Jahrb. **42:** 64 (1908). *C. boliviensis* Hack. in Fedde, Rep. Sp. Nov. **6:** 156 (1908). Plants to 8 dm. tall. Leaf-sheaths usually glabrous, the ligule to 5 mm. long; blades linear, flat, about 2-4 mm. wide, usually shorter than the inflorescence, glabrous to scabridulous or somewhat short-pilose above and beneath, at least when young. Panicles to 2 dm. long, narrow, dense, interrupted (mostly on the lower half), rachis and branches glabrous, pedicels scabrid, the branches short. Glumes to 4 (-4.5) mm. long, acute, the narrow keel scabridulous. Lemma sessile below the callus, about 0.5-1 mm. shorter than the longer glume, with 3 slender apical teeth, the lateral teeth shorter than the central tooth; callus sparsely short-villous, the hairs not over 0.5 mm. long; rachilla 0.5-1 mm. long, sparsely villous, the longest hairs not over 1 mm. long, about 1/3 the lemma-length; awn geniculate, to 5.5 mm. long, loosely twisted at the base, inserted at or below the middle of the lemma. LA PAZ: MURILLO: La Paz, 3700 m., *Buchtien* 8834 (GH).

6. **C. rigescens** (Presl) Scribner in Rept. Missouri Bot. Gard. **10:** 37 (1899). *Deyeuxia imberbis* Wedd. in Bull. Soc. Bot. France, **22:** 177, 180 (1875). Caespitose, rhizomatous, to 3 dm. tall. Leaf-sheaths glabrous, ligule to 1 mm. long; blades involute, shorter than inflorescence, glabrous to somewhat scabridulous. Inflorescence to 1 dm. long, narrow, the branches short, interrupted below, rachis usually glabrous below, puberulent-scabridulous above, branches and pedicels puberulent-scabridulous. Glumes to 5 mm. long, acute, the green midrib keeled and scabridulous above. Lemma about 0.5 mm. shorter than glumes, sessile below the callus, with 3-4 fine, short, apical teeth;

callus sparsely short-villous, the hairs less than 0.5 mm. long; rachilla glabrous, to nearly 2 mm. long; awn straight, to 4-4.5 mm. long, inserted at the middle of the lemma. LA PAZ: MURILLO: near La Paz, 3300 m., *Bang* 104 (GH).

C. chrysantha (Presl) Steud. Nomencl. (ed. 2) **1:** 250 (1840). *Deyeuxia phalaroides* Wedd. in Bull. Soc. Bot. France, **22:** 177, 180 (1875). *D. leiopoda* Wedd. in Bull. Soc. Bot. France, **22:** 177, 180 (1875). *Stylagrostis leiopoda* of the Catalogue. More or less rhizomatous, to 5 dm. tall. Leaf-sheaths glabrous, the ligule to 1.8 cm. long; blades involute, the apex pungent, much shorter than the inflorescence, glabrous, or scabridulous near the apex. Inflorescence golden-brown, oblong, to 6 cm. long, dense, the very short branches ascending, rachis, branches and pedicels mostly glabrous. Glumes to 7 (rarely 8) mm. long, acute or shortly bidentate at the apex, the midrib not prominent. Lemma stipitate below the callus, about 1-1.5 mm. shorter than the longer glume, 2-4-toothed; callus densely villous, the longest hairs 4-5 mm. long; rachilla to 1.5 mm. long, densely villous, the longest hairs to 5 mm. long; awn straight, 2-3 mm. long, shorter than the lemma, quickly deciduous, inserted about 1 mm. above the base of the lemma. LA PAZ: MURILLO: near La Paz, on the road to Coroico, 5000 m., *Mandon* 1319 (GH).

8. **C. ovata** (Presl) Steud. Nomencl. (ed. 2) **1:** 254 (1840). *Deyeuxia nivalis* Wedd. in Bull. Soc. Bot. France, **22:** 176, 180 (1875). *D. anthoxanthum* Wedd. in Bull. Soc. Bot. France, **22:** 176, 180 (1875). *D. capitata* Wedd. in Bull. Soc. Bot. France, **22:** 176, 180 (1875). *C. Pflanzii* Pilger in Engler, Bot. Jahrb. **49:** 184 (1912). Caespitose, to 3 dm. high. Leaf-sheaths glabrous, the ligule to 1.5 cm. long; blades flat to subinvolute, much shorter than the inflorescence. Panicle golden-brown, to 6-7 cm. long, dense, ovate, the branches short, ascending, rachis and branches mostly glabrous, pedicels sparsely puberulous. Glumes to 1 cm. long (rarely longer), long-acute, the midrib moderately prominent, often scabridulous. Lemma about 4 mm. long, stipitate below the callus, rather deeply bidentate; callus densely villous, the longest hairs 3-4 mm. long; rachilla to nearly 1.5 mm. long, glabrous below, the apical hairs to 3 mm. long; awn straight, mostly exceeding the lemma by about 1 mm., inserted somewhat above the base of the lemma. LA PAZ: LARECAJA: vic. Sorata; Anilaya, 3800-4500 m., *Mandon* 1320 (GH); MURILLO: near La Paz, on the road to Coroico, 5000 m., *Mandon* 1318 (US; type-number of *Deyeuxia nivalis*); NOR YUNGAS: at top of La Cumbre, 4500 m., *Eyerdam* 25112 (GH).

9. **C. vicunarum** (Wedd.) Pilger in Engler, Bot. Jahrb. **42:** 62 (1908). *C. pentapogonoides* O. Ktze. Rev. Gen. **3**(2): 344 (1898). Plants 5-25 cm. tall, caespitose. Leaf-sheaths glabrous, the ligule to 2 mm. long; blades pungent, filiform, involute, curled or flexuose, shorter (usually) than the inflorescence, glabrous above, the margins

scabrid, puberulous to scabridulous beneath, ultimately glabrescent below. Inflorescence oblong, spicate in appearance, occasionally interrupted below, 2-3 cm. long, the very short branches ascending, appressed, rachis, branches and pedicels rather sparsely scabridulous. Spikelets to 7 mm. long. Glumes as long as the spikelet, long-acute, scabridulous, especially near the upper portion of the scabridulous keel. Lemma sessile below the callus, 2-3 mm. shorter than the glumes, with 3-4 slender apical teeth; callus sparsely-villous, the longest hairs about 0.5 mm. long; rachilla 0.5-0.75 mm. long, slightly villous, the longest hairs about 1 mm. long; awn geniculate, basally twisted, about 5-6 mm. long, inserted 1 mm. above the base of the lemma. LA PAZ: MURILLO: La Paz, 4100 m., *Buchtien* (GH). COCHABAMBA: CERCADO: Putuyuni, 4000 m., *Steinbach* 4086 (GH).

10. **C. cryptolopha** (Wedd.) Hitchc. in Contrib. U. S. Nat. Herb. **24:** 374 (1927). To 8 dm. tall. Leaf-sheaths glabrous, the ligule 2-4 mm. long; blades mostly shorter than the inflorescence, nearly filiform, involute, scabridulous. Inflorescence narrow, dense, to 15 cm. long, sometimes interrupted below, the short (to 5 cm.) ascending branches appressed, rachis, branches and pedicels scabridulous. Glumes to about 6 mm. long, long-acute, scabridulous on and near the subprominent keel. Lemma sessile below the callus, about 1-1.5 mm. shorter than the glumes, shortly bidentate; callus rather sparsely villous, the longest hairs about 1 mm. long; rachilla about 1 mm. long, densely villous, the longest hairs about 2 mm. long; awn geniculate, the lower half loosely twisted, 4-5 mm. long, inserted about 1.5 mm. above the base of the lemma. LA PAZ: LARECAJA: Mt. Illampu, 3800 m., *Mandon* 1313 (GH; type-number).

11. **C. glacialis** (Wedd.) Hitchc. in Contrib. U. S. Nat. Herb. **24:** 375 (1927). *Deyeuxia picta* Wedd. in Bull. Soc. Bot. France, **22:** 177, 180 (1875). Height 3-5 dm. Leaf-sheaths scabridulous, ligule to 6 mm. long; blades shorter than or equaling the inflorescence, involute, stiff, scabridulous to glabrous. Inflorescence tawny-purple, to 20 cm. long, spicate in appearance, the rachis mostly glabrous, branches and pedicels sparingly scabrid on the angles. Glumes to 8 mm. long, acute to long-acute, glabrous to scabridulous, especially on the subprominent keel. Lemma to about 6 mm. long, sessile below the callus, deeply bidentate; callus rather sparsely villous, the longest hairs about 1 mm. long; rachilla about 2 mm. long, densely villous, the longest hairs about 4 mm. long, equaling the lemma; awn about 4 mm. long, straight, exceeding the lemma, inserted at or slightly below the middle of the lemma. LA PAZ: LARECAJA: vic. Sorata; Millipaya, 5000 m., *Mandon* 1312 (GH; type-number); MURILLO: Cerro de Huaina Potosí. *Germann* 1 (US); Illimani, 4850 m., *Hitchcock* 22590 (GH).

12. **C. Jamesonii** Steud. Syn. Pl. Glum. **1:** 191 (1854). Plant 7-33 cm. high, somewhat rhizomatous. Leaf-sheaths glabrous, the ligule to 2 mm. long; blades involute, shorter than or equaling the in-

florescence, obtuse to subacute, glabrous to puberulous. Inflorescence more or less ovoid, dense, 2-4 cm. long, occasionally somewhat interrupted below, the rachis, very short branches and pedicels villous to pubescent. Glumes to 6 mm. long, acute to subacute, glabrous to puberulent, the rather sharp keel pubescent-ciliate. Lemma sessile below the callus, about 4 mm. long, deeply bidentate, the teeth entire or toothed; callus very sparsely short-villous, the longest hairs less than 1 mm. long; rachilla 1.5 (-2) mm. long, densely long-villous, the longest hairs to 4 mm. long, equaling the lemma; awn straight, to 4 mm. long, much exceeding the lemma, inserted well below the middle of the lemma. LA PAZ: MURILLO: Chacaltaya, 4800 m., *Buchtien* 1193 (US).

This description is based on four topotypes, one of which is a probable isotype.

13. **C. curvula** (Wedd.) Pilger in Engler, Bot. Jahrb. **42**: 60 (1908). *C. variegata* O. Ktze. Rev. Gen. **3**(2): 354 (1898). Densely caespitose rhizomatous plants, to 3 dm. high. Leaf-sheaths glabrous, the ligule to 2 mm. long; blades involute, pungent, filiform, arcuate, scabridulous. Inflorescence spicate in appearance, oblong, to 4.5 cm. long (rarely to 7 cm.), the short branches ascending, rachis and branches glabrous, the pedicels glabrous to sparsely puberulent. Glumes to 5 mm. long, acute, glabrous, the keels scabridulous. Lemma sessile below the callus, about 3.5 mm. long, bidentate, the teeth broad and erosulous; callus villous, the longest hairs about 1 mm. long; rachilla about 2 mm. long or slightly longer, the longest hairs equaling or exceeding the lemma; awn straight to flexuose, but not geniculate, about 2 mm. long, equaling the lemma, inserted at the middle of the lemma or lower. POTOSÍ: SUR CHICHAS: Atocha, *Hitchcock* 22873 (GH).

14. **C. cephalantha** Filger in Engler, Bot. Jahrb. 42: 61 (1908). *Deyeuxia Lagurus* Wedd. in Bull. Soc. Bot. France, 22: 176, 180 (1875). Dwarf caespitose plants, usually to 4 cm. high, occasionally to 15 cm. high. Leaf-sheaths glabrous, inflated, the ligule to 2.5 mm. long; blades involute, 8 mm. to 2 cm. long, pubescent. Inflorescence ovate, to 2.5 cm. long, the very short branches ascending, rachis, branches and pedicels puberulent-scabridulous. Glumes to about 6 mm. long, acute, glabrous to puberulous above. Lemma sessile below the callus, to 4.5 mm. long, the apex several-toothed; callus densely villous, the longest hairs to 1 mm. long; rachilla to 3 mm. long, densely villous, the longest hairs to 4 mm. long, much exceeding the lemma; awn geniculate, the lower half twisted, to 6.5 mm. long, inserted somewhat below the middle of the lemma. LA PAZ: MURILLO: Chacaltaya, 4800 m., *Buchtien* 1195 (US).

15. **C. curta** (Wedd.) Hitchc. in Contrib. U. S. Nat. Herb. **24**: 376 (1927). Perennial, probably less than 10 cm. tall. Leaf-sheaths glabrous; blades glabrous, to 2.5 cm. long and less than 1 mm. wide,

flat or semi-involute, obtuse. Inflorescence a short, condensed, ovate panicle, less than 2 cm. long, the branchlets and pedicels puberulent. Glumes 6 mm. long, the midrib carinate and ciliate, upper portion of glumes scabridulous. Lemma nearly 4 mm. long, the apex with 4 short fine teeth; callus sparsely short-villous, the hairs about 0.5 mm. long; rachilla to nearly 2 mm. long, villous, the hairs about 1 mm. long; awn 4 mm. long, geniculate, inserted below the middle of the lemma and exceeding it. LA PAZ: LARECAJA: vic. Sorata, 4200 m., *Mandon* 1316 (US; type-number).

16. **C. brevifolia** (Presl) Steud. Nomencl. (ed. 2) 1: 240 (1840). Caespitose cushion-plants, the culms 2-4 dm. tall. Leaf-sheaths glabrous, the ligule to 2 mm. long; blades involute, filiform, arcuate or flexuose, pungent, scabridulous above, glabrous beneath, 2-10 cm. long. Inflorescence somewhat dense, oblong to oblong-ellipsoid, 3-7 cm. long, the short branches ascending-appressed or somewhat spreading at the base, the rachis usually glabrous, or sometimes sparsely puberulous or scabridulous, branches and pedicels glabrous to pubescent. Glumes to 7 mm. long, acute to subobtuse, the keel subprominent and scabridulous above. Lemma sessile below the callus, to 5 mm. long, the apex 3-4-toothed, the teeth short, delicate; callus densely villous, the longest hairs about 1 mm. long; rachilla to 3 mm. long, densely villous, the longest hairs to 4 mm. long, equaling or slightly exceeding the lemma; awn straight or flexuose, to 4 mm. long, slightly exceeding the lemma, inserted about 1.5-2 mm. above the base of the lemma. LA PAZ: MURILLO: La Paz, *Asplund* 6519 (Hitchcock).

17. **C. violacea** (Wedd.) Hack. ex Buchtien, Contrib. Fl. Bolivia, 1: 75 (1910). Caespitose, to 3 dm. tall. Leaf-sheaths puberulent-scabridulous, at least when young, the ligule acute, to 4 mm. long; blades filiform, involute, pungent, arcuate, scabridulous-puberulent, shorter than the inflorescence. Inflorescence rather open, to 6 cm. long, the branches 1.5-2.5 cm. long, rachis, branches and pedicels glabrous. Glumes to 6 mm. long, acute to shortly setaceous, purplish dorsally, the keel prominent and scabridulous above. Lemma about 0.5-1 mm. shorter than the glumes, sessile below the callus, with 3-4 short setaceous teeth at the apex; callus densely villous, the longest hairs to 2 mm. long; rachilla densely villous, the longest hairs 3 mm. long, equaling the lemma; awn straight or flexuose, about 4 mm. long, somewhat exceeding the lemma, inserted above the middle of the lemma. LA PAZ: OMASUYOS: near Achacache, 3950 m., *Mandon* 1307 (GH).

18. **C. tarmensis** Filger in Engler, Bot. Jahrb. 42: 70 (1908). *C. rosea* var. *macrochaeta* Hack, in Fries in Ark. Bot. 8: 40 (1908). Plants caespitose in dense tufts or fans, to 8 dm. tall. Leaf-sheaths glabrous, the truncate ligule 2-3 mm. long, erose; blades involute, filiform, flexuose to arcuate, stiffly coriaceous, scabridulous, shorter than to equaling the inflorescence. Panicle lax, 4-11 cm. long, narrow,

the branches ascending and appressed to somewhat spreading, rachis, branches and pedicels scabridulous to scabrid. Glumes 5-6 mm. long, acute, the keel prominent and scabridulous above. Lemma sessile below the calllus, 4 (-5) mm. long, with 3-4 fine, short, apical teeth, sometimes scabridulous above; callus sparsely short-villous, the longest hairs about 0.8 mm. long; rachilla about 2 mm. long, rather sparsely villous, the longest hairs 1.5-2 mm. long; awn geniculate, the tightly twisted basal half not equaling nor exceeding the glumes, inserted about 1 mm. above the base of the lemma, at least 6 mm. long. COCHABAMBA: CERCADO: south side of Mt. Tunari, 3600 m., *Steinbach* 9783, 9785, 9788 (all GH).

19. **C. tarijensis** Pilger in Engler, Bot. Jahrb. **42:** 71 (1908). Plants caespitose, to 9 dm. tall. Leaf-sheaths glabrous to scabridulous, the ligule to 2 mm. long, acute or subacute; blades involute, scabridulous. Panicle to 20 cm. long, lax, the branches to 5-6 cm. long, rachis, branches and pedicels scabridulous. Glumes about 5 mm. long, acute, the keel prominent and scabridulous above. Lemma sessile below the callus, about 4 mm. long, somewhat scabridulous above, with 4 short, slender, apical teeth; callus villous, the hairs to 1 mm. long; rachilla 1.5 mm. long, longest hairs to 1.5 mm.; awn geniculate, basal half twisted, equaling or exceeding the glumes, 6 mm. or more in length, inserted 1.5 mm. above the base of the lemma. COCHABAMBA: CERCADO: Mt. Tunari, 3600 m., *Steinbach* 9873 (GH). TARIJA: AVILES: Pinos, *Fiebrig* 3119 (GH).

20. **C. Fiebrigii** Pilger in Engler, Bot. Jahrb. **42:** 68 (1908). Caespitose, to 3 dm. tall. Leaf-sheaths glabrous, the ligule to 4 mm. long, acute; blades involute, erect, finely scabridulous beneath. Inflorescence 4-6 cm. long, rather dense, the short branches ascending, appressed, rachis and branches glabrous to scabridulous, the pedicels hispidulous. Glumes to 6 mm. long, acute, the keel scabridulous. Lemma sessile below the callus, to 5 mm. long, acute, shortly bidentate; callus villous, longest hairs 1 mm. long; rachilla 2.5 mm. long, villous, the longest hairs 3 mm. long, nearly equaling the lemma; awn geniculate, to 7 mm. long, basal half tightly twisted, inserted about 1.5 mm. above the base of the lemma and much exceeding it. TARIJA: CERCADO: Calderillo, 3300 m., *Fiebrig* 3191 (US; type-number).

21. **C. Antoniana** (Griseb.) Steud. ex Hitchc. in Contrib. U. S. Nat. Herb. **24:** 378 (1927). Caespitose, somewhat rhizomatous bunch-grass, to 6-8 dm. high. Leaf-sheaths usually glabrous, sometimes scabridulous, the ligule to 12 mm. long, acute; blades nearly as long as the inflorescence, involute, stiff, pungent, more or less scabridulous. Inflorescence narrow but rather lax, to 2 dm. long (but usually shorter ?), the branches to 3-4 cm. long, ascending-appressed to somewhat spreading, rachis and branches mostly glabrous, the pedicels sparsely scabrid-puberulent, especially near the apex. Glumes to 7 mm. long, acute to subacuminate, the keel scabridulous. Lemma sessile below the callus,

about 5 mm. long, scabridulous, bidentate, the thin teeth shortly bidentate; callus villous, the longest hairs to 1 mm. long; rachilla 1-1.5 mm. long, villous, the longest hairs to 4 mm. long, distinctly exceeding the lemma; awn geniculate to flexuose, the basal portion loosely twisted, to 4-6 mm. long, much exceeding the lemma, inserted at or somewhat below its middle. LA PAZ: MURILLO: La Cumbre, *Asplund* 6514 (US).

22. **C. Orbignyana** (Wedd.) Hitchc. in Contrib. U. S. Nat. Herb. **24:** 378 (1927). Caespitose, to 8 dm. tall. Leaf-sheaths glabrous, the ligule to 3 mm. long, acute to obtuse, emarginate to bidentate; blades filiform, involute, flexuose, much shorter than the inflorescence, scabridulous, the margins scabrid-ciliate. Inflorescence to 2 dm. long, narrow but lax, the branches to 4-5 cm. long, ascending to somewhat spreading, rachis and branches glabrous, the pedicels very sparsely scabrid to glabrous. Glumes about 5-6 mm. long, the keel scabridulous. Lemma sessile below the callus, 4-5 mm. long, very shortly 3-toothed; callus villous, the longest hairs 1.5 mm. long; rachilla 2 mm. long, villous, the longest hairs to 4 mm. long, equaling or slightly exceeding the lemma; awn about 4 mm. long, somewhat geniculate, the lower half loosely twisted, inserted at or below the middle of the lemma and somewhat exceeding it. LA PAZ: MURILLO: La Paz, 3750 m., *Buchtien* 180 (GH).

23. **C. intermedia** (Presl) Steud. Nomencl. (ed. 2) **1:** 250 (1840). *C. Humboldtiana* of the Catalogue. *Deyeuxia gracilis* Wedd. in Bull. Soc. Bot. France, **22:** 179 (1875). *D. Mandoniana* Wedd. in Bull. Soc. Bot. France, **22:** 179, 180 (1875). Caespitose, rhizomatous, 3-10 dm. high. Leaf-sheaths finely scabridulous to glabrous, the ligule to 1 cm. long, apically narrowed and toothed; blades involute, stiff, coriaceous, usually about as long as the inflorescence, or at least reaching its base, scabridulous, pungent. Inflorescence to 30 cm. long, lax, the lowest branches sometimes to 8-10 cm. long, ascending-spreading, somewhat interrupted, the rachis mostly glabrous, branches and pedicels quite sparsely scabrid. Glumes to 7 mm. long, acute to acuminate, the keels apically scabridulous. Lemma sessile below the callus, to 6 mm. long, usually densely scabridulous-puberulous, bidentate, the slender teeth bidentate; callus villous, the longest hairs nearly 1 mm. long, rarely a little longer; rachilla 2-2.5 mm. long, villous, the longest hairs about 4 mm. long, equaling the lemma; awn geniculate, twisted, inserted well below the middle of the lemma and much exceeding it. LA PAZ: MURILLO: La Paz, 4100 m., *Buchtien* 123 (GH); Palca, 3800 m., *Buchtien* 122 (GH); LARECAJA: vic. Sorata; Velatulini, 3700 m., *Mandon* 1308 (GH; type-number of *Deyeuxia Mandoniana*).

24. **C. minima** (Pilger) Tovar in Mem. Hist. Nat. Javier Prado, no. 11: 52 (1960). Dwarf, pulvinate, to 6 cm. tall. Leaf-sheaths glabrous, the ligule less than 0.5 mm. long, apically truncate and

ciliate, blades to 1 cm. long, involute, the apex obtuse, margins scabrid-ciliate. Inflorescence to 1.5 cm. long, narrow, spicate in appearance, few-flowered, the rachis, branches and pedicels glabrous to sparsely scabridulous. Glumes to 5.5 mm. long, acute, the upper margins sometimes erosulous, the keel scabridulous above. Lemma sessile below the callus, about 4 mm. long, scabridulous above, with several very fine apical teeth; callus villous, the longest hairs less than 1 mm. long; rachilla about 0.5 mm. long, sparsely villous, the longest hairs to 1 mm. long; awn nearly 5 mm. long, geniculate, inserted about 0.5 mm. above the base of the lemma and much exceeding it. LA PAZ: MURILLO: La Paz, 4200 m., *Asplund* 6518 (US); La Cumbre, 4650 m., *Asplund* 6511 (US); Chacaltaya, 4800 m., *Buchtien* 1202 (US).

25. **C. trichophylla** Pilger in Engler, Bot. Jahrb. **42:** 67 (1908). Caespitose, rhizomatous, to 5 dm. high. Leaf-sheaths glabrous, the ligule to 2.5 mm. long, subobtuse; blades involute, filiform, flexuose to straight, margins scabridulous, subacute to obtuse, shorter than the inflorescence. Inflorescence lax, open, narrow, to 9 cm. long, rachis, branches and pedicels sparsely scabrid. Glumes to 5 mm. long, acute, the keel scabridulous. Lemma sessile below the callus, about 3.5 mm. long, bidentate, the slender teeth bidentate; callus villous, the longest hairs about 1 mm. long; rachilla to 1.5 mm. long, sparsely villous, the longest hairs somewhat less than 1 mm. long; awn 4 mm. long, geniculate, inserted less than 1 mm. above the base of the lemma and exceeding it. COCHABAMBA: CHAPARE: 50 km. northeast of Cochabamba, on road to Chimoré, 1700 m., *Eyerdam* 25038 (GH).

26. **C. recta** (HBK.) Trin. ex Steud. Nomencl. (ed. 2) **1:** 251 (1840). *Deyeuzia sulcata* Wedd. in Bull. Soc. Bot. France, **22:** 178, 180 (1875). Bunch-grass, to 9 dm. high. Leaf-sheaths glabrous or scabridulous near the apex, ligule to 5 mm. long, truncate, the apex erose; blades involute, stiff, obtuse, nearly equaling or exceeding the inflorescence. Panicle to 25 cm. long, lax, interrupted, the lower branches to 7-8 cm. long, rachis, branches and pedicels scabrid to hispidulous. Glumes to 7 mm. long, acute, the prominent keel scabridulous. Lemma sessile below the callus, about 5 mm. long, bidentate; callus villous, the longest hairs somewhat less than 1 mm. long; rachilla to 2 mm. long, the longest hairs about 1.5 mm. long; awn geniculate, to 6-7 mm. long, inserted 1.5-2 mm. above the base of the lemma and much exceeding it. LA PAZ: LARECAJA: vic. Sorata; Puerta del Inca, 3700 m., *Mandon* 1308 bis (GH; type-number of *Deyeuxia sulcata*). COCHABAMBA: CERCADO: Cuesta Tabacruz, Tunari, 4500 m., *Steinbach* 9789 (GH).

27. **C. longiaristata** (Wedd.) Hack. in Sodiro in Anal. Univ. Quito, **1889:** 8 (1998). *C. Beyrichiana* of the Catalogue. *C. montevidensis* var. *linearis* Hack. in Fedde, Rep. Sp. Nov. **6:** 156 (1908). Plant to 8 dm. tall. Leaf-sheaths glabrous, the ligule to 4 mm. long, truncate, laciniate-dentate; blades flat, to 20 cm. long and 7 mm. wide, scabrid

above and beneath. Inflorescence lax, open, to 2.5 dm. long, the lowest branches up to 15 cm. long, ascending-spreading to arcuate, rachis, branches and pedicels scabridulous. Glumes to 6 mm. long, very narrow, acute, the inconspicuous keel finely scabridulous. Lemma sessile below the callus, to 4.5 mm. long, acute, bidentate; callus densely villous, longest hairs as long as the lemma; rachilla nearly 2 mm. long, the lower portion glabrous, the apex sparsely villous with hairs 2.5-3 mm. long; awn to 9 mm. long, straight, divergent from the very base, inserted well above the middle of the lemma and far exceeding it. LA PAZ: NOR YUNGAS: Unduavi, *Buchtien* 8910 (US); SUR YUNGAS: Sirupaya, *Buchtien* 430 (US).

28. **C. densiflora** (Presl) Steud. Nomencl. (ed. 2) 1: 250 (1840). Caespitose, to 6 dm. tall. Leaf-sheaths glabrous, the ligule to 7 mm. long, subtruncate, erose-dentate; blades involute, acute to pungent, to 15 cm. long, scabridulous. Inflorescence to 18 cm. long, dense, the short ascending branches appressed, rachis, branches and pedicels scabridulous-puberulous. Glumes about 6 mm. long, acute, scabridulous on the upper portion and keel. Lemma sessile below the callus, almost as long as the glumes, somewhat scabridulous, bidentate; callus glabrous or with a very few hairs to 0.4 mm. long; rachilla about 2 mm. long, villous, the longest hairs 3 mm. long; awn straight, to 5 mm. long, inserted at or below the middle of the lemma and exceeding it. LA PAZ: MURILLO: Palca, *Pflanz* 296 (US).

The Pflanz specimen is without data except for the number. However, I have records for his nos. 295 and 297, which were collected at Palca. Thus, it seems probable that this is the locality for no. 296.

29. **C. polygama** (Griseb). Parodi in Physis, **9**: 13, 14 (1928). *C. Lilloi* of the Catalogue. Caespitose, to 1-1.8 m. high. Leaf-sheaths glabrous, the ligule to 2.5 mm. long, acute to subobtuse; blades flat to folded, shorter than the inflorescence, scabridulous. Inflorescence a lax open panicle to 4 dm. long and 15 cm. wide, the spreading branches distant, rachis, branches and pedicels scabridulous. Glumes 3 mm. long, acute, scabridulous on the keel. Lemma sessile below the callus, as long as the glumes or a little longer, scabridulous, bidentate; callus villous, the longest hairs 0.8 mm. long; rachilla 1.5 mm. long, the longest hairs 1.5 mm. long, equaling the lemma; awn flexuose, about 2 mm. long, inserted shortly below the middle of the lemma and about equaling it. COCHABAMBA: CERCADO: west of Cochabamba, *Hitchcock* 22838 (GH); Vinto, 2500 m., *Parodi* 10234 (Parodi).

30. **C. viridiflavescens** (Poir.) Steud. Nomencl. (ed. 2) 1: 251 (1840). *C. montevidensis* of the Catalogue. Plant to 1 m. tall. Leaf-sheaths glabrous, ligule about 1 mm. long, deeply dissected-fimbriate; blades flat, to 7 mm. wide, usually much shorter than the inflorescence, scabridulous above and beneath. Inflorescence to 3 dm. long, loose, rather narrow, somewhat nutant, the lower branches sometimes to 10

cm. long, rachis and branches mostly glabrous, the pedicels scabridulous. Glumes to 4 mm. long, acute to acuminate, the keel scabridulous. Lemma sessile below the callus, about 3 mm. long, bidentate, the 2 teeth shortly fimbriate; callus densely villous, the longest hairs exceeding the lemma; rachilla about 1 mm. long, glabrous except for a very few hairs at the apex, hairs to 2.5 mm. long; awn divergent from the base, straight, about 6 mm. long, inserted above the middle of the lemma and much exceeding it. LA PAZ: SUR YUNGAS: San Felipe, 2800 m., *Hitchcock* 22601 (GH).

31. **C. spicigera** (Presl) steud. Nomencl. (ed. 2) **1:** 251 (1840). *Deyeuxia obtusata* Wedd. in Bull. Soc. Bot. France, **22:** 177, 180 (1875). *D. subsimilis* Wedd. in Bull. Soc. Bot. France, **22:** 178, 180 (1875). Stoloniferous, to 5 dm. tall. Leaf-sheaths glabrous, the ligule to 2 mm. long; blades involute, arcuate to flexuose, usually glabrous, occasionally puberulous, mostly shorter than the inflorescence. Inflorescence to 6 cm. long, dense, spicate in appearance, the short branches ascending, appressed, rachis glabrous to puberulent, branches and pedicels puberulent to hispidulous. Glumes to 8 mm. long, acute, the keel scabridulous. Lemma sessile below the callus, to 6.5 mm. long, bidentate, the 2 teeth bidentate; callus villous, the longest hairs to 2 mm. long; rachilla to 2.5 mm. long, villous, the longest hairs to 5 mm. long, equaling or slightly exceeding the lemma; awn geniculate, the basal portion twisted, inserted about 2 mm. above the base of the lemma and equaling or slightly exceeding it. LA PAZ: LARECAJA: vic. Sorata, *Mandon* 1311 (Tovar).

38. **Agrostis** L.

Perennials. Leaf-blades flat to involute. Inflorescence a terminal racemose panicle, from dense and spicate in appearance to lax and diffuse. Spikelets 1-flowered, disarticulation above the glumes. Glumes subequal, or, if unequal, the first longer than the second. Lemma hyaline, awned or awnless, much shorter than the glumes; palea present and obvious, or very minute, or absent.

a. Panicle sometimes narrow, but open to diffuse, not spicate.
  b. Panicle narrow, spikelets many.
    c. Palea present, obvious.
      d. Lemmas awned. ..... 1. *A. gelida.*
      d. Lemmas awnless. ..... 2. *A. stolonifera.*
    c. Palea absent or very minute. ..... 8. *A. exasperata.*
  b. Panicle open to diffuse, spikelets few.
    e. Lemmas awnless. ..... 5. *A. perennans.*
    e. Lemmas awned.
      f. Spikelets all long-pedicellate. ..... 4. *A. montevidensis.*
      f. Spikelets partly short-pedicellate, partly long-pedicellate. ..... 6. *A. boliviana.*

a. Panicle narrow, but not open nor diffuse, sometimes spicate.

g. Palea present. ..... 3. *A. verticillata.*
g. Palea absent.
h. Panicle spicate; lemma 1.5 mm. long.
i. Panicle short (to 7 cm.), not interrupted. ..... 7. *A. Haenkeana.*
i. Panicle long (to 15 cm.), interrupted, at least on the lower half. ..... 10. *A. tolucensis.*
h. Panicle narrow, loose; lemma 2 mm. long. .... 9. *A. araucana.*

1. **Agrostis gelida** Trin. in Mém. Acad. St. Pétersb. (ser. 6) Sci. Nat. 4(1): 343 (1841). Laxly caespitose, to 1 m. tall. Leaf-sheaths glabrous to scabridulous, ligule to 8 mm. long, abaxially pubescent; blades often long, flat, to 7-8 mm. wide, usually narrower, scabridulous beneath. Panicle narrow but lax, to 3 dm. long, the primary branches verticillate, bearing spikelets only from well above the middle, rachis mostly glabrous, branches and pedicels sparsely to densely scabridulous to scabrid. Glumes 3-4 mm. long, acuminate to subaristate, more or less sparsely scabridulous. Lemma to 2 mm. long, more or less truncately obtuse at the apex, the straight awn about 3 mm. long, inserted below the middle of the lemma and equaling or exceeding the glumes; palea nearly as long as the lemma, about 1.5 mm. LA PAZ: MURILLO: Pongo, *Hitchcock* 22781 (US).

2. **A. stolonifera** L. Sp. Pl. 62 (1753). Basally spreading, the culms to 5 dm. long. Leaf-sheaths glabrous, the ligule to 6 mm. long, glabrous; blades flat, to 3 mm. wide, scabridulous above and beneath. Panicle to 20 cm. long, rather open but narrow, the primary branches verticillate, rachis glabrous, the branches bearing spikelets nearly to the base, the branches and pedicels scabridulous to nearly glabrous. Glumes to 2-2.5 mm. long, acute, the keel scabridulous on the upper half. Lemma about 1.5 mm. long, acute to subobtuse, awnless (rarely awned); palea half as long as the lemma, obtuse. LA PAZ: MURILLO: Pongo, *Hitchcock* 22784 (US).

3. **A. verticillata** Vill. Prosp. Pl. Dauph. 16 (1779). Decumbent to spreading, sometimes stoloniferous, the culms to 5 dm. long (rarely up to 1 m.). Leaf-sheaths glabrous, the ligule 4-5 mm. long, abaxially short-scabrid, apically ciliate-fimbriate; blades mostly short, flat, to 7 mm. wide, scabrid above and beneath. Panicle dense, interrupted, to 15 cm. long, rachis glabrous, branches and pedicels mostly glabrous, occasionally sparsely scabridulous, the verticillate primary branches short, bearing spikelets to the base. Glumes about 2 mm. long, acute, scabridulous, the keel scabrid. Lemma awnless, about 1-1.5 mm. long, obtuse and toothed at the apex; palea as long, or nearly so. COCHABAMBA: CERCADO: Valle de Cochabamba, 2600 m., *Steinbach* 8773 (GH).

4. **A. montevidensis** Spreng. ex Nees, Agrost. Bras. 403 (1829). Slender, erect, culms to 2-3 dm. high. Leaf-sheaths glabrous, ligule to 4 mm. long, apically rounded, glabrous; blades short, flat, 1(-3)

mm. wide, scabridulous above and beneath. Panicle rather diffuse, rachis, branches and elongated pedicels variously scabridulous, primary branches verticillate and bearing spikelets only near the apex. Glumes 2-3 mm. long, acute, the keels scabrid. Lemma about 1.5 mm. long, the awn to 3.5 mm. long, geniculate, inserted nearly at the base of the lemma; palea absent. COCHABAMBA: CHAPARE: Llanta-Aduana, 2800-3200 m., *Steinbach* 8830 (GH, US); Cerro San Benito, 3400 m., *Steinbach* 9649 bis (GH).

5. **A. perennans** (Walt.) Tuckerm. in Amer. Journ. Sci. **45: 44** (1843). Decumbent to erect, the culms to 5-10 dm. high. Leaf-sheaths glabrous, ligule to 5 mm. long, glabrous, narrowed above, the apex obtuse and sparsely erose-dentate; blades relatively short, flat, to 3 mm. wide, scabridulous above and beneath. Panicle open, to 2 dm. long, rachis, branches and pedicels glabrous, the primary branches verticillate, rebranched, the spikelets borne at or near the apices on long pedicels. Glumes 2-3 mm. long, acute to acuminate, the keels sometimes scabridulous near the apex. Lemma 1.5-2 mm. long, bidentate, awnless or with a short awn (to 1.25 mm.) inserted at base of sinus between the teeth; palea absent or extremely minute. LA PAZ: MURILLO: Unduavi, 3200 m., *Buchtien* 2585 (GH); NOR YUNGAS: Bella Vista, *Hitchcock* 22757 (GH). COCHABAMBA: CHAPARE: Incachaca, 2250 m., *Steinbach* 9497 (GH); La Aduana, 2850-3000 m., *Steinbach* 9695 (GH).

6. **A. boliviana** Mez in Fedde, Rep. Sp. Nov. **18: 1** (1922). Somewhat lax, culms to nearly 6 dm. tall. Leaf-sheaths glabrous, the ligule to 6 mm. long, glabrous, apex bluntly rounded to deeply fimbriate; blades about 3 mm. wide, scabridulous above and beneath. Panicle open, to 18 cm. long, the rachis and branches glabrous, the pedicels sometimes sparsely scabridulous, the primary branches rebranched verticillately, the long-pedicellate spikelets borne toward the ends of the secondary branches. Glumes to 3.5 mm. long, acute, the keel finely scabridulous above. Lemma 2 mm. long, deeply bidentate, the flexuose to geniculate awn to 4.5 mm. long, inserted below the middle of the lemma; palea absent. TARIJA: CERCADO: Calderillo, 3200 m., *Fiebrig* 2905 (GH).

7. **A. Haenkeana** Hitchc. in Contrib. U. S. Nat. Herb. **24: 381** (1927). Caespitose, spreading to erect, the culms to 5 dm. tall, but usually much shorter. Leaf-sheaths glabrous, the ligule to 4 mm. long, rounded or fimbriate-dentate at the apex, glabrous; blades usually short, to 3 mm. wide, flat to involute, glabrous above and beneath. Panicle dense, spicate in appearance, to 7 cm. long, rachis, branches and pedicels glabrous, or the pedicels scabridulous, the short branches erect, appressed, bearing spikelets to the base (the lowest spikelets often aborted and reduced to pedicellate rudiments). Glumes to 3.5 mm. long, acute, somewhat scabridulous, the keel scabridulous above. Lemma 1.5 mm. long, the apex truncate and finely denticulate,

awned, the awn straight, flexuose or geniculate, to 2.5 mm. long, inserted above the middle of the lemma; palea absent or extremely minute. LA PAZ: LARECAJA: Puerto del Inca, 3800 m., *Mandon* 1292 (GH).

8. **A. exasperata** Trin. in Mém. Acad. St. Pétersb. (ser. 6) Sci. Nat. 4(1): 352 (1841). Erect to decumbent, the culms to 1 m. tall, usually shorter. Leaf-sheaths glabrous, the ligule to 5 mm. long, abaxially scabrid or scabridulous, the apex subobtuse to truncately acute, erose-dentate; blades flat, to 3-4 mm. wide, scabridulous above and beneath. Panicle rather dense, subpyramidal, to 15 cm. long, the rachis glabrous below, scabridulous above, the whorled primary branches and pedicels scabridulous to scabrid. Glumes mostly 3 mm. long, acute to long-acuminate and subaristate, densely scabridulous to scabrid, the keel markedly scabrid. Lemma to 1.5 mm. long, rather deeply bidentate, the straight awn to 2.5 mm. long, inserted at the middle of the lemma and equaling or very slightly exceeding the glumes; palea about 0.4 mm. long. LA PAZ: MURILLO: Palca, *Buchtien* 2531 (US).

9. **A. araucana** Phil. in Anal. Univ. Chile, **94**: 14 (1896). Caespitose, to 5 dm. tall. Leaf-sheaths glabrous, the ligule to 4 mm. long, abaxially scabridulous, the apex truncate and dentate; blades flat to loosely involute, to 3 mm. wide, scabridulous above and beneath. Panicle narrow, to 15 cm. long, the rachis, ascending-appressed branches and pedicels scabridulous to scabrid, the long-pedicellate spikelets borne nearly to the base of the branches. Glumes to 3.5 mm. long, acute, glabrous or sometimes faintly scabridulous, the keel finely scabridulous. Lemma to nearly 2 mm. long, bidentate, the geniculate awn to 4 mm. long, inserted below the middle of the lemma and much exceeding the glumes; palea absent or very minute. LA PAZ: MURILLO: Unduavi, *Buchtien* 2581 (Hitchcock).

10. **A. tolucensis** HBK. Nov. Gen. & Sp. **1**: 135 (1816). Erect or spreading, to 6 dm. tall. Leaf-sheaths glabrous, the ligule to 5 mm. long, acute, glabrous; blades flat to involute, to 2 mm. wide, scabridulous above and beneath. Panicle narrow, to 15 cm. long, dense, interrupted below, more or less spicate in appearance, rachis and branches glabrous to scabridulous, the pedicels scabridulous. Glumes 2.5-3 mm. long, acute, glabrous to scantily scabridulous, the keel scabridulous. Lemma 1.5 mm. long, bidentate, the straight awn about 2.5 mm. long, inserted at or above the middle of the lemma and much exceeding the glumes (awns sometimes absent); palea absent. LA PAZ: SUR YUNGAS: San Felipe, 2800 m., *Hitchcock* 22600 (GH).

39. Alopecurus L.

See Parodi in Revist. Fac. Agron. Vet. Buenos Aires, **7**: 345-369 (1931).

Erect or decumbent perennials or annuals, 50 cm. to 1 m. high. Leaf-blades flat, to 6 mm. wide, glabrous beneath, scabrid above, the uppermost sometimes equaling or slightly exceeding the inflorescence. Inflorescence a condensed panicle, spicate in appearance. Spikelets 1-flowered, strongly flattened, disarticulation below the equal glumes. Lemmas about as long as the glumes, awned; palea lacking.

Awns nearly 5 mm. long; inflorescence to 3 cm. long, nearly 1 cm. wide. ..... 1. *A. bracteatus.*

Awns 1 mm. long; inflorescence about 5 cm. long, about 4 mm. wide. ..... 2. *A. aequalis.*

1. **Alopecurus bracteatus** Phil. in Anal. Univ. Chile, **94**: 6 (1896). Perennial. Spikelets 3-4 mm. long. Glumes 3-4 mm. long, the keel long-ciliate, the hairs up to 1.5 mm. long, the 2 lateral veins silky-villous. Lemmas 3-3.5 mm. long, the upper margins ciliolate, otherwise glabrous, the awn inserted well below the middle of the lemma. LA PAZ: LARECAJA: vic. Sorata; Alto de Ticonguaya, 4100 m., *Mandon* 1244 (GH); MURILLO: La Paz, 3750 m., *Buchtien* 431 (GH), 502 (GH), 861 (GH); Pelaya, 4000 m., *Hitchcock* 22585 (GH).

2. **A. aequalis** Sobol. Fl. Petrop. 16 (1799). Annual. Spikelets about 2.5 mm. long. Glumes about 2 mm. long, the keel ciliolate but not densely long-silky. Lemmas 2.5 mm. long, the awn about 1 mm. long, hardly or not at all exserted from the glumes, inserted near the apex of the lemma. LA PAZ: MURILLO: vic. La Paz, 5000 m., *Mandon* 1243 (GH).

Alopecurus Hitchcockii L. R. Parodi in Revist. Fac. Agron. Vet. Buenos Aires, **7**: 366 (1931). Described as having the inflorescence 4 cm. long, 5-6 mm. wide. Spikelets 2.5 mm. long. Lemma-awn 1.5 mm. long, inserted at 1/3 the length of the lemma, not, or only very slightly, exceeding the glumes.

From the description, this seems unduly close to **A. aequalis.** It probably should not be maintained as distinct.

40. **Polypogon** Desf.

Perennial, in wet or damp habitats, to 1 m. high, leaf-blades flat. Inflorescence a narrow, dense, interrupted panicle, the 1-flowered spikelets disarticulating below the equal, awned glumes; lemma shorter than the glumes, thin-textured, usually awned, the awn inserted below the apex.

Glumes gradually attenuate into the awns, about 3 mm. long. ..... 1. *P. elongatus.*

Glumes abruptly obtuse, not narrowed into the awns, about 2 mm. long. ..... 2. *P. interruptus.*

1. **Polypogon elongatus** HBK. Nov. Gen. & Sp. **1**: 134 (1816). Awns 1-1.5 mm. long, glumes scabrid-puberulent. Lemma 2 mm. long, the apex 2-4-toothed, the awn about 2 mm. long. LA PAZ: LARECAJA:

vic. Sorata, *Mandon* 1294 (GH); SUR YUNGAS: San Felipe, 2800 m., *Hitchcock* 22599 (GH).

2. **P. interruptus** HBK. No. Gen. & Sp. 1: 134 (1816). *P. lutosus* of the Catalogue. Awns 2.5-3 mm. long, glumes, especially the first, densely scabrid-puberulent. Lemma about 1 mm. long, apex toothed, awn about 2.5-3 mm. long. LA PAZ: MURILLO: cañon of Río de La Paz, 3355 m., *Shepard* 160 (GH); La Paz, 3300 m., *Rusby* 40 (GH), *Bang* 47 (GH), 3650 m., *Buchtien* 169 (GH), 238 (GH). COCHABAMBA: CERCADO: foothills of Mt. Tunari, 3400 m., *Steinbach* 9768 (GH); Valle de Cochabamba, *Steinbach* 8773 (GH), 8789 (GH); CHAPARE: Sacaba, 2900 m., *Steinbach s.n.* (GH); MIZQUE: Vilavila, 2600 m., *Eyerdam* 25321 (GH). POTOSÍ: CERCADO: Potosí, 4000 m., *Cárdenas* 206 (GH).

41. **Lycurus** HBK.

Lycurus phleoides HBK. Nov. Gen. & Sp. 1: 142 (1816). Perennial, somewhat caespitose, to 3 dm. high. Leaves mostly basal, crowded, the sheaths puberulent to scabrid. the short flat blades scabridulous above and beneath, scabrid-ciliate. Inflorescence a terminal dense panicle, spicate in appearance, to 5 cm. long, the branchlets and pedicels scabridulous. Spikelets 1-flowered, paired, 1 spikelet perfect, the other staminate or sterile, the pair falling as a unit, disarticulation below the glumes. Glumes about equal, or the second longer than the first, 1.5-2 mm. long, 2-awned, the awns to 6 mm. long, the keels scabrid-ciliolate. Lemmas to 4 mm. long with a 3 mm. straight awn, 3-nerved, the margins villous-ciliate on the lower half. Palea as long as the lemma, villous on the keels. LA PAZ: MURILLO: Capi, *Bang* 762 (GH). COCHABAMBA: CERCADO: west of Cochabamba, *Hitchcock* 22822 (GH). POTOSÍ: CERCADO: Potosí, 4000 m., *Cárdenas* 204a (GH).

42. **Muhlenbergia** Schreb.

See Parodi in Physis, 9: 205-222 (1928).

Annual or perennial, from dwarf plants a few centimeters high to about 1 m. high. Leaf-blades flat to involute. Inflorescence a racemose panicle, from dense and spicate to diffuse. Spikelets 1-flowered (2-3-flowered in one species), disarticulation above the awnless glumes. Lemma firm-textured, awned, the awn terminal, or very shortly cuspidate; palea similar to lemma and about as long, awnless.

a. Second glume deeply tridentate. ..... 1. *M. peruviana.*

a. Second glume entire.

b. Panicle spicate in appearance. ..... 7. *M. angustata.*

b. Panicle not spicate.

c. Panicle open to diffuse.

d. Lemma to 1.5 mm. long, awned, the awn to 5 mm. long. .... 3. *M. tenuissima.*

d. Lemma to 2 mm. long, awnless, but shortly cuspidate. ..... 4. *M. asperifolia.*

c. Panicle narrow.

e. Lemma awnless.

f. Leaf-blades flat; rhizome absent. ..... 5. *M. ligularis.*

f. Leaf-blades involute; slender scaly rhizome present. ..... 6. *M. fastigiata.*

e. Lemma awned.

g. Awn over 1 cm. long.

h. Lemma 2.5-3 mm. long. ..... 2. *M. quitensis.*

h. Lemma to 6-7 mm. long. ..... 9. *M. rigida.*

g. Awn 3-4 mm. long. ..... 8. *M. Holwayorum.*

1. **Muhlenbergia peruviana** (Beauv.) Steud. Nomencl. (ed. 2) 1: 41 (1840). *M. Herzogiana* Henrard in Meded. Rijks Herb. Leiden, no. 40: 58 (1921). Caespitose annual, 2-20 cm. high. Leaf-sheaths glabrous, ligule to 2 mm. long, acute to subobtuse; blades involute, very short, glabrous. Panicle to 2 cm. long, narrow, rather dense, rachis, branches and pedicels scabridulous. First glume entire, acute, to 1.5 mm. long; second glume to 2.25 mm. long, deeply tridentate. Lemma to 2.25 mm. long, scabridulous to pubescent, slightly bidentate, the straight or flexuose awn to 4 mm. long (rarely to 1.5 cm.); palea nearly as long as the lemma, sparsely pubescent. LA PAZ: MURILLO: La Paz, 4100 m., *Buchtien* 72 (GH). POTOSÍ: CERCADO: Potosí, 4000 m., *Cárdenas* 196 (GH); LINARES: Lagunillas, 3800 m., *Cárdenas* 483 in part (GH; originally entangled in a *Stevia,* no. 483). COCHABAMBA: CERCADO: Mt. Tunari, 3800 m., *Steinbach* 9849 (GH). TARIJA: CERCADO (?): Cuesta San Anaton, 3000 m., *Fiebrig* 3277 (GH).

2. **M. quitensis** (HBK.) Hitchc. in Contrib. U. S. Nat. Herb. **17:** 292 (1913). Annual, 3-9 dm. high. Leaf-sheaths slightly scabridulous, the ligule to 4 mm. long; blades flat or involute, scabridulous, short (to 5 cm.), 2 mm. wide. Inflorescence narrow but loose, interrupted, to 2 dm. long, the primary branches bearing spikelets almost to the base. First glume to 2 mm. long, acute; second glume to 2.5-3 mm. long, entire, subulate-aristate. Lemma about 2.5-3 mm. long, subbidentate, the awn to 2 cm. long; palea pubescent at the base. Without locality: *Bang* 947 (Hitchcock).

3. **M. tenuissima** (Presl) Kunth, Rév. Gram. **1:** suppl. XVI (1830). Delicate annual, to 2 dm. tall, occasionally taller. Leaf-sheaths glabrous to puberulous, the ligule to 2 mm. long, the apex rounded to subacute; blades short, flat, about 1 mm. wide, sparsely pubescent above and beneath, or almost glabrous. Panicle 10 cm. long, open, the primary branches apparently secund on occasion, rachis, branches and pedicels mostly glabrous. First glume to 1 mm. long, acute; second glume to 1.5 mm. long, long-acute or acuminate. Lemma (excluding awn) 1.5 mm. long, scabridulous, subbidentate, the straight awn to 5 mm. long; palea as long as lemma, somewhat puberulent at

base. LA PAZ: SUR YUNGAS: La Florida, 1840 m., *Hitchcock* 22622 (GH). COCHABAMBA: TARATA: Anzaldo, *Cárdenas* 2477 (GH).

4. **M. asperifolia** (Nees & Meyen) Parodi in Physis, **9**: 210 (1928). Perennial, decumbent, to 4 dm. tall, with creeping rhizomes. Leaf-sheaths finely scabridulous to glabrous, the ligule 1-2 mm. long, apex rounded, ciliate or fimbriate-denticulate; blades short, flat, to 1.5 mm. wide, not falcate, scabridulous above and beneath. Panicle open, very diffuse, the primary branches rebranched, the branchlets bearing solitary long-pedicellate spikelets at the ends, branchlets and pedicels sparsely to rather densely scabridulous. Spikelets often 2-flowered, rarely 3-flowered, the florets distant on a glabrous rachilla. First glume to 1.75 mm. long, acute, somewhat scabridulous, especially on the keel; second glume to 2.25 mm. long, scabrid on the keel, the apex narrowly subtruncate, the midrib excurrent as a short scabridulous cusp. Lemma dark purple, at least in part, to 2 mm. long, slightly bidentate, the cusp less than 0.5 mm. long; palea as long as the lemma, bidentate, each tooth cuspidate. POTOSÍ: SUR CHICHAS: Oploca, *Hitchcock* 22891 (GH).

5. **M. ligularis** (Hack.) Hitchc. in Contrib. U. S. Nat. Herb. **24**: 388 (1927). Decumbent tufted perennial, not rhizomatous, culms to 10 cm. high. Leaf-sheaths glabrous to finely papillate-scabridulous, the ligule to 4 mm. long, more or less acute; blades flat, to 2 mm. wide, rarely over 2 cm. long, finely papillate-scabridulous above and beneath. Panicle short, hardly 4 cm. long, narrow, few-branched, rachis, branches and short pedicels finely scabridulous. Glumes subequal, about 1 mm. long, the apex usually rounded, occasionally truncately subacute, the keel not prominent. Lemma to 2 mm. long, callus glabrous, finely scabridulous above, the midrib slightly excurrent as a cusp 0.2 mm. long; palea as long as the lemma. LA PAZ: MURILLO: vic. La Paz, 3300 m., *Bang* 109 (GH); LARECAJA: Millipaya, 3700 m., *Mandon* 1286 (GH).

6. **M. fastigiata** (Presl) Henrard in Meded. Rijks Herb. Leiden, no. 40: 59 (1921). Tufted creeping perennial, a few centimeters high, with spreading, slender, scaly rhizomes. Leaf-sheaths finely papillate, ligule about 1-1.5 mm. long, acute; blades involute, falcate, seldom over 1 cm. long, finely papillate. Panicle to 1 cm. long, narrow, few-flowered, rachis, branches and short pedicels finely papillate to scabridulous. Glumes subequal, slightly over 1 mm. long, acute, keel prominent, scabridulous. Lemma to 2.5 mm. long, acute, the apex with a cusp about 0.2-0.4 mm. long; palea about as long as the lemma, hardly cuspidate. LA PAZ: MURILLO: La Paz, 4100 m., *Buchtien* (GH). TARIJA: AVILES: Puna Patanca, 3700 m., *Fiebrig* 2633 (GH).

7. **M. angustata** (Presl) Kunth, Rév. Gram. **1**: suppl. XVI (1830). Caespitose perennial, to 8 dm. tall. Leaf-sheaths scabridulous, the ligule to 1.1 cm. long, rounded to acute at the apex; blades long, folded to involute, densely scabridulous. Panicle dense, spicate in

appearance, to 15 cm. long, rachis, branches and short pedicels densely scabrid to densely short-hispid. Glumes equal or subequal, to 6-7 mm. long, acute, scabridulous. Lemma as long as the glumes, scabridulous, the straight awn to 3 mm. long; palea slightly shorter than the lemma, scabridulous, acute to subbidentate. LA PAZ: LARECAJA: near Millipaya, 3600 m., *Mandon* 1279 (GH). TARIJA: CERCADO: Calderillo, *Fiebrig* 3173 (GH).

8. **M. Holwayorum** Hitchc. in Contrib. U. S. Nat. Herb. **24:** 389 (1927). Caespitose perennial to 6 dm. high. Leaf-sheaths glabrous, the ligule to 5 mm. long; blades flat to involute, to 3 mm. wide, scabridulous. Panicle narrow, to 2 dm. long, the rachis, appressed branches and pedicels scabridulous. Glumes subequal, about 1.5 mm. long, acute. Lemma to 3-4 mm. long, the awn to 3-4 mm. long; palea as long as the lemma. LA PAZ: LARECAJA: Sorata, *Holway & Holway* 530 (US; type).

9. **M. rigida** (HBK.) Kunth, Rév. Gram. **1:** 63 (1829). *M. phragmitoides* of the Catalogue. Caespitose perennial, to 8 dm. tall. Leaf-sheaths finely puberulent to scabridulous, the ligule to 4 mm. long, apically dentate; blades firm, involute, scabridulous (at least above), acute. Panicle narrow, lax, not spicate in appearance, to 3 dm. long, the rachis, ascending branches and long pedicels scabridulous. Glumes subequal, to 2 mm. long, acute. Lemma to 6-7 mm. long, scabridulous, the awn to 1.5 cm. long; palea slightly shorter than the lemma. LA PAZ: MURILLO: Obrajes, 3350 m., *Buchtien* 819 (GH); LARECAJA: San Pedro, 2600-2700 m., *Mandon* 1280 (GH).

43. **Triniochloa** Hitchc.

Triniochloa stipoides (HBK.) Hitchc. in Contrib. U. S. Nat. Herb. **17:** 303 (1913). Perennial, to 1 m. high. Leaf-sheaths and blades puberulent, the blades very narrow and sometimes involute. Inflorescence a lax, few-flowered panicle, to 2 dm. long, the branches scabridulous. Spikelets 1-flowered, disarticulation above the glumes, to 1.2 cm. long (excluding the awn). Glumes equal, thin-textured, 2-3 mm. long, acute, 1-nerved, the keels scabridulous. Lemma nearly terete, rather indurate, to 1.2 cm. long, scabrid-puberulent on the upper portion, bidentate, the dorsal geniculate awn to nearly 2 cm. long, the lower half loosely twisted, the callus densely villous with hairs to 1.5 mm. long. Palea as long as the lemma and as firm-textured, deeply bidentate, the keels scabridulous. LA PAZ: NOR YUNGAS: Unduavi, 3800 m., *Buchtien* 4172 (GH).

44. **Aciachne** Benth.

See Chase in Journ. Wash. Acad. Sci. **14:** 364-366 (1924).

Aciachne pulvinata Benth. in Hook. Ic. Pl. **4:** 44, t. 1362 (1881). Low-growing, less than 10 cm. high, densely caespitose perennial, in

wide-spread clumps. Leaf-blades involute, glabrous, falcate, pungent, about 1 cm. long. Inflorescence a single 1-flowered perfect spikelet, terminal on a solitary peduncle, hardly, or not at all, raised above the leaves, disarticulation above the glumes. Glumes equal, about 2 mm. long, more or less indurate, produced into a long, sharp awn-like point. Palea much shorter than the lemma and more or less enclosed by it, the rounded apex bifid. LA PAZ: LARECAJA: vic. Sorata; Chilcani, 3600-4200 m., *Mandon* 1287 (GH). COCHABAMBA: CHAPARE: Cumbre de San Benito, 3600 m., *Steinbach* 9888 (GH). Locality uncertain: *Fiebrig* 3571 (GH), *Bang* 1843 (GH).

45. **Sporobolus** R. Br.

See Parodi in Revist. Fac. Agron. Vet. Buenos Aires, **6**: 115-168 (1928).

Annual or perennial. Ligule obsolete, reduced to a semi-lunate line of hairs. Leaf-blades involute or flat. Inflorescence a panicle, open or spicate in appearance, often subpyramidal. Spikelets 1-flowered, disarticulation above the unequal glumes. Lemma and palea similar in appearance, the palea frequently splitting. Caryopsis turbinate-pyriform to oblong-ovoid, readily shed.

a. Primary branches not in whorls.
  b. Spikelets hardly 1 mm. long; panicle very open and diffuse. .... 1. *S. tenuissimus.*
  b. Spikelets 2-3 mm. long.
    c. Panicle narrow, spicate in appearance; spikelets to 3 mm. long. .... 4. *S. Poiretii.*
    c. Panicle more open, not spicate; spikelets 2 mm. long, or less. .... 5. *S. indicus.*
a. Primary panicle-branches in whorls.
  d. Spikelets about 2 mm. long. .... 2. *S. argutus.*
  d. Spikelets 3-4 mm. long. .... 3. *S. aeneus.*

1. **Sporobolus tenuissimus** (Mart. ex Schrank) O. Ktze. Rev. Gen. **3**(2): 369 (1898). Annual, delicate, to 7 dm. high, glabrous, the culms compressed. Leaf-blades linear, to 3 mm. wide, sometimes equaling the inflorescence. Panicle to 3.5 dm. long, narrow, very open, the primary branches not whorled, branches ascending to spreading, pedicels delicate, long. Spikelets 1 mm. long, or less. First glume to 0.3 mm. long, narrowly linear; second glume 0.6 mm. long, narrowly deltoid. Lemma ovate to obovate, 1 mm. long or less, acute; palea as long, broader, the apex truncate to obtusely rounded. Caryopsis turbinate-pyriform, broadest at the apex or very near it. SANTA CRUZ: SARA: between the Río Cuchi and Río Piray, *Herzog* 1446 (Hitchcock).

2. **S. argutus** (Nees) Kunth, Enum. Pl. **1**: 215 (1833). Spreading to suberect perennial, to 5 dm. tall. Leaf-sheaths glabrous; blades glabrous, the margins scabrid, linear, to 7-8 cm. long and 5 mm. wide,

flat to folded or subinvolute. Panicle to 10 cm. long, narrow, narrowly pyramidal at maturity, the primary branches in whorls, rachis, branches and pedicels glabrous. Spikelets about 2 mm. long. First glume 0.5 mm. long, oblong-ovate, subobtuse; second glume 1.75 mm. long, acute. Lemma 1.5 mm. long, acute; palea shorter and broader. Caryopsis oblong-ovoid, broadest at the middle. LA PAZ: MURILLO: La Paz, 3300 m., *Bang* 79 (GH).

3. **S. aeneus** (Trin.) Kunth, Rév. Gram. **1**: suppl. XVII (1830). Densely caespitose perennial, to 6 dm. tall. Leaf-sheaths glabrous, the margins ciliate; blades long, narrow, folded or involute, pilose at the base on the adaxial surface, the margins ciliate. Panicle subpyramidal, narrow, to 3 dm. long, primary branches in distant whorls, floriferous nearly to the base, rachis, branches and pedicels glabrous. Spikelets 3-4 mm. long. First glume about 1.5 mm. long, lance-linear; second glume as long as the spikelet, 1-nerved. Lemma to 3-4 mm. long, lanceolate, acute, 3-nerved; palea as long as lemma. Caryopsis oblong-ovoid, broadest at the middle. LA PAZ: LARECAJA: Hacienda Casana, *Buchtien* 7147 (Hitchcock).

4. **S. Poiretii** (Roem. & Schult.) Hitchc. in Bartonia, **14**: 32 (1932). *S. Berteroanus* of the Catalogue. Perennial, to 1 m. tall. Leaves glabrous, the blades sometimes equaling the inflorescence, flat below to involute above, to 5 mm. wide at the base. Inflorescence to 4 dm. long, usually much shorter, spicate in appearance, the primary branches not in whorls, rachis glabrous, branches and pedicels usually glabrous, sometimes sparsely scabridulous. Spikelets to 3 mm. long. First glume 0.5-1 mm. long, oblong-ovate, the apex truncate and erosulous; second glume 1.5 mm. long, acute, the upper margins erose. Lemma nearly 3 mm. long, acute to subobtuse; palea similar, but slightly shorter. Caryopsis turbinate-pyriform, broadest near or at the apex. LA PAZ: LARECAJA: Sorata, *Mandon* 1285 (GH); MURILLO: La Paz, 3700 m., *Buchtien* 179 (GH); NOR YUNGAS: Milluguaya, 1300 m., *Buchtien* 4187 (GH). COCHABAMBA: CHAPARE: Sacaba, 2900 m., *Steinbach* 8808 (GH); CERCADO: Mollemolle, 2800 m., *Steinbach* 4054 (GH). SANTA CRUZ: SARA: Buenavista, 500 m., *Steinbach* 5148 (GH).

5. **S. indicus** (L.) R. Br. Prodr. Fl. Nov. Holl. **1**: 170 (1810). Perennial, to 8 dm. tall. Leaves glabrous, the blades chiefly involute, to 2 mm. wide at the base, shorter than the inflorescence. Panicle interrupted at the base, branches not whorled, moderately long and ascending to spreading, rachis, branches and pedicels glabrous to sparsely scabridulous. Spikelets 2 mm. long or less. First glume less than 0.5 mm. long, obtuse to truncate and erosulous; second glume somewhat less than 1 mm. long, acute or subacute. Lemma about 2 mm. long, acute; palea similar, usually somewhat shorter. SANTA CRUZ: ICHILO: Río Palometillas, 400 m., *Steinbach* 7933 (GH); SARA:

Buenavista, 450-500 m., *Steinbach* 6701 (GH), 6843 (GH), 6844 (GH), 6852 (GH), 6854 (GH).

Sporobolus eximius (Nees) Ekm. was included among the Bolivian species by Hitchcock, on the basis of a Fiebrig collection from Toldos. This locality is in Argentina. I have seen no Bolivian material of the species.

46. **Nassella** (Trin.) E. Desv.

See Parodi in Darwiniana, **7**: 369-395 (1947).

Perennials, often caespitose. Leaf-blades flat or convolute. Inflorescence a panicle, the 1-flowered spikelets disarticulating above the glumes. Glumes equal or unequal, rather thin, mostly hyaline. Lemma obliquely obovoid, gibbous toward the apex, often somewhat apiculate or mucronulate, enclosing the short membranous palea. Awn excentrically attached, caducous.

a. Glumes equal, or if unequal, not markedly so; lemma villous, callus villous.
   b. Lower portion of awn villous; callus acute. .... 1. *N. Asplundii.*
   b. Lower portion of awn scabrous; callus obtuse. .... 2. *N. pubiflora.*
a. Glumes markedly unequal; lemma glabrous or nearly so; callus glabrous or with a few short hairs. ..... 3. *N. Meyeniana.*

1. **Nassella Asplundii** Hitchc. in Contrib. U. S. Nat. Herb. **24**: 394 (1927). Caespitose, to 6 dm. tall. Leaf-sheaths glabrous or sparsely villous at the apex; blades involute, to 5 cm. long (occasionally longer). Panicle to 1.5 dm. long, open, the capillary branches naked below, axis and branches glabrous, pedicels scabrous-hirsutulous. Glumes to 4 mm. long, 3-nerved, the first glume ciliate on the keel. Lemma densely villous, 2.5 mm. long, the oblique apex unilaterally apiculate. Awn to 1.5 cm. long. POTOSÍ: Porco: Uyuni, 3500 m., *Asplund* 6548 (US; type).

2. **N. pubiflora** (Trin. & Rupr.) Desv. in Gay, Fl. Chile, **6**: 264 (1853). *N. flaccidula* Hack. and *N. flaccidula* var. *humilior* Hack. in Fedde, Rep. Sp. Nov. **6**: 155 (1908). *N. deltoidea* Hack. in Fedde, Rep. Sp. Nov. **11**: 23 (1912). ? *Stipa tiraquensis* O. Ktze. Rev. Gen. **3**(2): 373 (1898). *Stipa Pflanzii* Mez in Fedde, Rep. Sp. Nov. **17**: 206 (1921). Caespitose, 5-9 dm. tall. Leaf-sheaths glabrous to scabrous; blades flat or subconvolute, glabrous, to 20 cm. long. Panicle to 2 dm. long, the lower branches naked on the basal third, axis scabridulous, branches and pedicels puberulent to shortly pubescent. Glumes 3.5-5 mm. long, 3-nerved, the first glume sparsely ciliate on the keel. Lemma villous, 2-2.4 mm. long, the obtuse callus villous; awn geniculate, to 1.5 cm. long, the base scabrous. LA PAZ: LARECAJA: vic. Sorata; Puquesani, 2700-3000 m., *Mandon* 1270 (GH); Catarguata, 3000 m., *Mandon* 1270 bis (GH; in part); MURILLO: La Paz, *Buchtien* 8541

(GH), 9309 (GH); Cerro del Calvario, 3800 m., *Buchtien* 145 (Hitchcock); Palca, 3700 m., *Hitchcock* 22579 (GH).

3. **N. Meyeniana** (Trin. & Rupr.) Parodi in Darwiniana, **7**: 379 ((1947). *N. corniculata* Hack. in Fedde, Rep. Sp. Nov. **5**: 155 (1908). Caespitose, to 6 dm. tall. Leaf-sheaths glabrous or somewhat pubescent at the apex; blades flat or subconvolute, to 20 cm. long, glabrous or dorsally pubescent. Panicle narrow, somewhat interrupted, to 25 cm. long, branchlets covered by spikelets to the base, axis and branchlets glabrous, the pedicels hispidulous on the angles. Glumes glabrous, markedly unequal, the first glume 4-4.5 mm. long, the second glume 3.5-4 mm. long. Lemma 1.8-2.2 mm. long, glabrous, shining, the obtuse callus glabrous or with a few short hairs, awn 1-1.5 cm. long, weakly or not at all geniculate. LA PAZ: MURILLO: La Paz, *Bang* 40 (GH); La Paz, 3700 m., *Buchtien* 366 (GH).

47. **Piptochaetium** Presl

See Parodi in Revist. Mus. La Plata (n. s.) Bot. **6**: 213-310 (1944).

Piptochaetium panicoides (Lam.) E. Desv. in Gay, Fl. Chile, **6**: 270 (1853). *P. setifolium* and *P. tuberculatum* of the Catalogue. Caespitose perennial to 4 dm. tall. Leaves mostly basal, shorter than the inflorescence, the glabrous involute blades to 15 cm. long and 0.5 mm. wide. Inflorescence a terminal racemose panicle, to 1 dm. long, few-flowered, the rachis, branches and pedicels puberulent-scabridulous. Spikelets 1-flowered, disarticulation above the glumes. Glumes subequal, 3.5-4 mm. long, acuminate, several-nerved, glabrous. Lemma more or less D-shaped, to 2.5 mm. long, thick, firm-textured, surrounding the caryopsis and almost concealing the palea, finely striate, with a short apical collar strongly oblique at the summit, bearing a geniculate, loosely twisted excentric awn to 1 cm. long. Palea coriaceous, with 2 keels. (Department and province unknown): Alto de Cuchilla, 2600 m., *Troll* 839 (Parodi).

P. panicoides f. **subpapillosum** (Hack.) Parodi in Revist. Mus. La Plata (n. s.) Bot. **6**: 302 (1944). A form with the lemma more or less papillose-tuberculate. LA PAZ: LARECAJA: vic. Sorata; Munaypata, 2650-2900 m., *Mandon* 1274 (GH).

48. **Stipa** L.

See Hitchcock in Contrib. U. S. Nat. Herb. **24**: 263-289 (1925).

Perennial. Leaf-blades mostly involute, sometimes flat. Inflorescence a panicle. Spikelets 1-flowered, disarticulation above the glumes; callus sharply pointed. Glumes hyaline-membranous. Lemma indurate, mostly fusiform, with a terminal twisted awn.

a. Glumes unequal, the outer much longer than the inner.
  b. Longest glumes 1 cm. or more in length.
    c. Lemma with an apical crown.

d. Lemma about 8 mm. long. ..... 9. *S. Neesiana.*
d. Lemma about 3 mm. long. ..... 11. *S. depauperata.*
c. Lemma without an apical crown. ..... 18. *S. Holwayi.*
b. Longest glumes to 7 mm. long. ..... 3. *S. pampagrandensis.*
a. Glumes equal or subequal, but the outer not much longer than the inner.
e. Longest glumes about 1 cm. or more in length.
f. Lemma with an apical crown.
g. Lemma 5-6 mm. long, villous below and nearly to apex; crown conspicuous, ciliate with short, thick, hispid hairs. ..... 8. *S. mucronata.*
g. Lemma 4 mm. long, appressed-villous, crown short. .... 12. *S. brachyphylla.*
f. Lemma without an apical crown.
h. Awn plumose on one segment.
i. Lemma to 9 mm. long; awn plumose on basal segment only. ..... 1. *S. speciosa.*
i. Lemma to 5 mm. long; awn plumose on terminal segment only. ..... 2. *S. plumosa.*
h. Awn not plumose, but sometimes pubescent or subvillous.
j. Lemma to 4 mm. long, villous, the apical hairs to 3 mm. long. ..... 6. *S. nardoides.*
j. Lemma to 8 mm. long, sparsely villous, or glabrous, the apical hairs, if any, short. ..... 14. *S. curviseta.*
e. Longest glumes less than 1 cm. long; lemma lacking an apical crown.
k. Awn straight or flexuose, but not geniculate.
l. Apex of lemma with a dense ring of hairs 3-4 mm. long; lemma fusiform or subfusiform.
m. Lemma glabrous or sparsely villous at base or apex. ..... 7. *S. Hans-meyeri.*
m. Lemma sparsely pubescent or short-villous.
n. Lemma to 3 mm. long. ..... 4. *S. Ichu.*
n. Lemma to 4-5 mm. long. ..... 5. *S. capilliseta.*
l. Apex of lemma without a dense ring of hairs.
o. Lemma-apex broad, truncate; awn slightly excentric. .... 19. *S. florulenta.*
o. Lemma-apex attenuate, not truncate; awn not excentric.
p. Glumes acute; lemma glabrous above, sparsely pubescent below. ..... 16. *S. polyclada.*
p. Glumes more or less obtuse; lemma glabrous, save for a few short hairs near apex. ..... 15. *S. obtusa.*
k. Awn geniculate.
q. Lemma obovoid, apex truncate. ..... 10. *S. inconspicua.*
q. Lemma narrowly ellipsoid to fusiform, apex attenuate.
r. Lemma 3 mm. long, sparsely villous. .... 13. *S. dasycarpa.*

r. Lemma at least 4 mm. long.
s. Plants to 2.5 dm. tall; lemma short-pilose. ..... 17. *S. illimanica.*
s. Plants to 4-6 dm. tall; lemma sparsely short-pilose. ..... 20. *S. Trollii.*

1. **Stipa speciosa** Trin. & Rupr. in Mém. Acad. St. Pétersb. (ser. 6) Sci. Nat. 5(1): 45 (1843). To 6 dm. tall, rigid, erect, the brown bases glabrous to pubescent. Leaves involute, acute to pungent, glabrous, or the margins loosely long-ciliate. Panicle rather dense, to 1 dm. long, the axis glabrous to scabrid to pubescent, the pedicels scabrid to pubescent and villous at the apex. Glumes thin, subequal or the outer shorter, long-acuminate, to 2.2 cm. long, 1-3-nerved, glabrous. Lemma to 9 mm. long, densely pubescent to villous. Awn to 6 cm. long, once-geniculate, twisted and plumose below the geniculation, glabrous above it. ORURO: POOPÓ: Pasña, *Buchtien* 1184 (US); PORCO: Uyuni, *Asplund* 6552 (US).

2. **S. plumosa** Trin. in Mém. Acad. St. Pétersb. (ser. 6) Sci. Nat. 4(2): 37 (1836). Erect to straggling, somewhat woody, to 2 m. tall, the base leafless or covered with old, glabrous to pubescent leaf-sheaths. Leaf-blades involute or subinvolute, long-ciliate, acute. Panicle somewhat lax, narrow, to 2 dm. long, the axis and branchlets mostly glabrous, pedicels glabrous to scabrid and short-pubescent on the angles. Glumes thin, papery, long-acuminate, 3-nerved, sparsely villous, usually on the midrib, to 1.2 cm. long. Lemma to 5 mm. long, pubescent to short-villous, glabrous near the apex and with an apical ring of sparse stiff hairs. Awn strongly geniculate or curved, to 4 cm. long, the basal section twisted and pubescent to short-villous, the upper section plumose. SANTA CRUZ: VALLEGRANDE: Comarapa, *Herzog* 1885 (US). POTOSÍ: PORCO: Uyuni, *Asplund* 6563 (US).

3. **S. pampagrandensis** Speg. in Anal. Mus. Nac. Montevideo, 4: 158 (1910). To 10 dm. tall, erect, glabrous. Leaf-blades involute. Panicle narrow, lax to 2 dm. long, somewhat exceeding or nearly equaled by the leaf-blades, axis glabrous, pedicels scabrid. Glumes unequal, the outer much longer than the inner, to 7 mm. long, long-attenuate to almost aristate, thin, 3-nerved. Lemma more or less obovoid, glabrous, irregularly rugulose or papillate-striate, to 3 mm. long. Awn to 5 cm. long, geniculate or strongly curved, the lower portion loosely twisted and scabridulous, the upper portion straight and glabrous to minutely scabridulous. TARIJA: CERCADO: Junaca, *Fries* 1308 (US).

4. **S. Ichu** (Ruíz & Pav.) Kunth, Rév. Gram. 1: 60 (1829). Caespitose, erect, glabrous, to 1.5 m. high. Leaf-blades involute, pungent. Panicle to 4 dm. long, lax, rather narrow, often silvery in color, the axis glabrous, branchlets and pedicels finely scabridulous. Glumes subequal or equal, thin, papery, long-acute, to 8 mm. long. Lemma fusiform, to 3 mm. long, sparsely pubescent, with a dense apical ring of hairs to 3-4 mm. long. Awn to 1.7 cm. long, scabridulous, not

geniculate but somewhat flexuose, the basal portion loosely twisted. La Paz: larecaja: Río Challasuyos between Lojena and Illampú, 2650-3800 m., *Mandon* 1273 (gh); murillo: La Paz, 3750 m., *Buchtien* 185 (gh); Palca, *Hitchcock* 22581 (gh). Potosí: cercado: Potosí, 4000 m., *Cárdenas* 199 (gh), 205 (gh). Cochabamba: chapare: Cuchicanchi, 3300 m., *Steinbach* 9632 (gh).

5. S. **capilliseta** Hitchc. in Contrib. U. S. Nat. Herb. **24:** 271 (1925). Caespitose, glabrous, to 5 dm. tall. Leaf-blades about equaling the base of the inflorescence, pungent, involute. Panicle narrow, to 15 cm. long, axis, branches and pedicels scabrid. Glumes subequal, to 7 mm. long, hyaline, papery, obscurely 3-nerved, scabridulous near base and along midrib, long-acute. Lemma 4-5 mm. long, fusiform, sparsely pubescent to short-villous, especially below, the apex with denser hairs to 4 mm. long. Awn to 2 cm. long, scabridulous, not geniculate but the lower portion loosely twisted. Potosí: nor lipez: Chiguana, 3700 m., *Asplund* 6566 (us; type).

6. S. **nardoides** (R. A. Phil.) Hack. ex Hitchc. in Contrib. U. S. Nat. Herb. **24:** 271 (1925). Densely caespitose, to 4 dm. high. Leaf-sheaths short-pubescent, short-villous at the apex; blades short, involute, obtuse to subpungent. Panicle narrow, to 1 dm. long, axis, branches and pedicels puberulent to scabridulous. Glumes subequal, glabrous, to 1 cm. long, long-acute, obscurely 3-nerved, purplish, the margins and apex white-hyaline. Lemma to 4 mm. long, terete or subfusiform, densely short-villous, the longer apical hairs to 3 mm. long. Awn to 2 cm. long, geniculate, basal portion tightly twisted, somewhat puberulous, upper portion shortly puberulous. Oruro: porco: Uyuni, *Asplund* 6539 (us).

7. S. **Hans-meyeri** Pilger in Engler, Bot Jahrb. **56**, Beibl. 123: 24 (1920). Caespitose, glabrous, to 5 dm. tall. Leaf-blades involute, pungent. Panicle dense, to 10 (-20) cm. long, purple or brownish-purple, axis, branches and pedicels scabridulous. Glumes equal or subequal, to 7 mm. long, long-acute, glabrous. Lemma subfusiform, to 3.5 mm. long, sparsely villous at base and apex, the apical ring of hairs dense and to 3 mm. long. Awn about 1 cm. long, curved but not strongly geniculate, the base puberulent, the upper portion finely scabridulous. La Paz: larecaja: inter Millipaya et Velatutini, 3700 m., *Mandon* 1272 bis (gh).

8. S. **mucronata** HBK. Nov. Gen. & Sp. **1:** 225 (1816). Caespitose, to 10 dm. tall, erect or geniculate, mostly glabrous. Leaf-blades often about equaling the inflorescence, flat or somewhat folded, sparsely scabrid beneath, the margins coarsely ciliate. Panicle to 3 dm. long, lax, the axis glabrous, branches and pedicels somewhat puberulent-scabridulous. Glumes subequal, or the outer slightly longer, about 1 cm. long, long-acute, the midrib and margins often coarsely and sparsely hispid-ciliate. Lemma to 5-6 mm. long, subfusiform, villous below and nearly to the summit, the apex developed into a crown

terminated by short stiff hairs. Awn to 3 cm. long, twice bent, the lowest portion tightly twisted and pubescent, the central portion loosely twisted and scabridulous, the terminal portion straight and only minutely scabridulous. LA PAZ: MURILLO: La Paz, 3750 m., *Buchtien* 3692 (GH), 430 (GH); LARECAJA: vic. Sorata, 2600-2700 m., *Mandon* 1276 (GH). COCHABAMBA: CERCADO: Mollemolle, 2800 m., *Steinbach* 4056 (GH).

9. **S. Neesiana** Trin. & Rupr. in Mém. Acad. St. Pétersb. (ser. 6) Sci. Nat. 5(1):27 (1843). To 10 dm. tall, caespitose, mostly glabrous, the nodes usually pubescent to villous. Leaf-blades flat to folded, scabridulous beneath, the margins hispid-ciliate. Panicle to 2 dm. long, axis glabrous, branches and pedicels scabridulous to hispidulous. Glumes somewhat unequal, the outer longer, to 1.5 cm. long, long-acute, the midribs often hispid. Lemma to 8 mm. long, pubescent to villous below, the upper portion glabrous, smooth to papillate-rugose, the apical crown often long. Awn twice-bent or twice-geniculate, to 1.5 cm. long, the lowest portion tightly twisted and pubescent, the central portion loosely twisted and puberulent, the terminal portion straight and puberulent to scabridulous. LA PAZ: LARECAJA: Sorata, *Rusby* 237 (US). COCHABAMBA: CERCADO: Cochabamba, *Holway* 328 (US).

Extreme forms of *S. Neesiana* and *S. mucronata* appear quite distinct, but enough intergradation occurs to make their specific distinctness appear somewhat questionable.

10. **S. inconspicua** Presl, Rel. Haenk. 1: 277 (1830). *Nassella flaccidula* Hack. in Fedde, Rep. Sp. Nov. 6: 154 (1908). Caespitose, to 4.5 dm. tall, glabrous. Leaf-blades flat or involute, the uppermost equaling or exceeding the inflorescence. Panicle to 10 cm. (occasionally to 18 cm.), narrow, the branches quite distant, axis and branches glabrous, branchlets and pedicels puberulent to scabridulous. Glumes subequal or the outer slightly longer, acute, several-veined, about 3.5 mm. long. Lemma more or less obovoid, 2.5-3 mm. long, sparsely pubescent. Awn to 1.5 cm. long, once-geniculate, scabridulous, the lower portion twisted, the upper portion straight. LA PAZ: MURILLO: La Paz, *Holoway* 600 (US).

11. **S. depauperata** Pilger in Engler, Bot. Jahrb. 56, Beibl. 123: 23 (1920). Caespitose, spreading, to 5 dm. tall, mostly glabrous. Leaves short, the involute blades rarely equaling the base of the inflorescence. Panicle narrow, to 15 cm. long, brownish to purplish, axis glabrous, branchlets and pedicels from glabrous to pubescent. Glumes unequal, to 1 cm. long, long-acute, the midribs minutely scabridulous, otherwise glabrous. Lemma fusiform, to 3 mm. long, pubescent (sometimes sparsely so), the apical crown quite short. Awn to 1.5 cm. long, geniculate, the lower portion tightly twisted and short-pubescent, the upper portion straight and puberulent to scabridulous. LA PAZ: MURILLO: La Paz, *Holway* 492 (US).

12. S. **brachyphylla** Hitchc. in Contrib. U. S. Nat. Herb. **24:** 275 (1925). Caespitose, to 4 dm. tall, glabrous. Leaves short, the blades involute, pungent, upper surface scabrid. Panicle lax, narrow, to 1 dm. long, axis and branches glabrous, branchlets and pedicels puberulent to short-hispid. Glumes somewhat unequal or subequal, to 1 cm. long, acute or acuminate, the midrib of outer glume often sparsely appressed-hispid. Lemma fusiform, about 4 mm. long, or a little longer, appressed-villous, the apical crown short. Awn to 2.5 cm. long, twice-geniculate, lowest portion tightly twisted and pubescent, central portion more loosely twisted and puberulent, upper portion straight, minutely puberulent to scabridulous. LA PAZ: MURILLO: La Paz, *Holway* 433 (US); OMASUYOS: Yumari, 3850 m., *Asplund* 6557 (US).

13. S. **dasycarpa** Hitchc. in Contrib. U. S. Nat. Herb. **24:** 281 (1925). To 3-4 dm. tall. Leaf-blades involute, glabrous on the lower surface, puberulous on the upper surface. Panicle rather lax, to 1.5 dm. long. Glumes equal, 5 mm. long, acuminate. Lemma about 3 mm. long, fusiform, sparsely villous, apical crown lacking, callus 0.5 mm. long. Awn 2 cm. long, twice-geniculate, the lower 2 segments appressed-villous. POTOSÍ: NOR LIPEZ: Chiguana, *Asplund* 6562 (Hitchcock).

14. S. **curviseta** Hitchc. in Contrib. U. S. Nat. Herb. **24:** 282 (1925). Caespitose, to 5 dm. tall. Leaf-blades involute, glabrous or scabridulous beneath, pubescent above. Panicle lax, to 2 dm. long, axis glabrous, branches and pedicels pubescent to scabrid. Glumes subequal, to 1.5 cm. long, long-acuminate. Lemma terete, to 8 mm. long, sparsely villous to glabrate, apical crown obscure, ciliate, callus to 3.5 mm. long. Awn to 7 cm. long, twice-geniculate, the lowest portion twisted and villous, the terminal segment flexuose, decreasingly villous toward the end. POTOSÍ: PORCO: Uyuni, 3700 m., *Asplund* 6551 (US; type); SUR CHICHAS: Atocha, 3700 m., *Asplund* 6550 (US), 6547 (US); NOR LIPEZ: Chiguana, 3700 m., *Asplund* 6554 (US).

15. S. **obtusa** (Nees & Mey.) Hitchc. in Contrib. U. S. Nat. Herb. **24:** 284 (1925). *S. boliviensis* Pilger in Engler, Bot. Jahrb. **56:** 26 (1920). Caespitose, to 4 dm. high, glabrous. Leaf-blades involute, pungent, scabridulous, some equaling or exceeding the inflorescence-base. Panicle narrow, to 15 cm. long, axis, branches and pedicels scabridulous. Glumes equal or subequal, about 3 mm. long, broadly ovate, abruptly short-acute or subobtuse, the second glume often subtridentate. Lemma narrowly elliptic-fusiform, to 3 mm. long, glabrous save for a few short sparse hairs at or near the apex. Awn to 1 cm. long, not geniculate, not twisted, scabrid to scabridulous. LA PAZ: MURILLO: La Paz, 4100 m., *Buchtien* 184 (GH). COCHABAMBA: CERCADO: south side of Mt. Tunari, 3600 m., *Steinbach* 9786 (GH).

16. S. **polyclada** Hack. ex Stuck. in Anal. Mus. Nac. Buenos Aires, **21:** 80 (1911). Straggling, the branches fascicled at the nodes. Leaf-blades involute to flat, pungent, short. Panicle lax, to 1 dm. long,

axis and branches glabrous (sometimes scabridulous), pedicels puberulent to scabridulous. Glumes hyaline, about 3 mm. long, acute, subequal. Lemma to 2.5 mm. long, narrowly ellipsoid, glabrous above, sparsely appressed-pubescent below, the apex attenuate. Awn to 2.5 cm. long, variously bent but not geniculate, scabridulous.

I have seen no Bolivian material on this species. In his treatment of the Andean grasses (1927) and his synopsis of South American *Stipa* (1925), Hitchcock cited *Asplund* 6563 as the basis for the inclusion of Bolivia in the range. The sheet of this number at Washington seems to me to be *Stipa plumosa*. Consequently, the occurrence of *Stipa polyclada* in Bolivia is problematical.

17. **S. illimanica** Hack. in Fedde, Rep. Sp. Nov. **11:** 22 (1912). Caespitose, to 2.5 dm. tall. Leaf-blades flat or loosely involute, the margins scabrid. Panicle narrow, to 1.4 dm. long, axis glabrous. Glumes subequal, to 6 mm long, acute, 3-nerved. Lemma to 4-4.5 mm. long, short-pilose, the apex scabrid, apical crown lacking, callus short (0.5 mm.), pubescent. Awn to 3 cm. long, geniculate, the base loosely twisted and pubescent, the terminal portion puberulent to scabrid. LA PAZ: MURILLO: Cotaña, 2450 m., *Buchtien* 3134 (US; type-number).

18. **S. Holwayi** Hitchc. in Contrib. U. S. Nat. Herb. **24:** 287 (1925). To 1 m. tall. Leaf-blades flat or involute, narrow, glabrous beneath, short-pubescent on upper surface. Inflorescence a narrow, lax panicle to 2.5 dm. long, axis glabrous, branches and pedicels shortly puberulous to hispid, especially near the apex of panicle. Glumes to 1.1 cm. long, unequal, the outer 1.5 mm. longer than the inner, 3-nerved, acuminate. Lemma to 5-6 mm. long, the callus to 1 or 1.5 mm. long and densely pubescent, fusiform, villous, the apex with an obscure crown. Awn to 4.5 cm. long, twice-geniculate, the 2 lower portions twisted and scabrid-pubescent, the terminal portion to 2-3 cm. long, flexuose, glabrous to scabridulous. ORURO: ABAROA: Challapata, 2900 m., *Asplund* 6546 (US). COCHABAMBA: CERCADO: Cochabamba, *Holway* 380 (US; type).

19. **S. florulenta** (Pilger) Parodi in Rev. Mus. La Plata (n. s.) Bot. **6:** 307 (1944). *Oryzopsis florulenta* of the Catalogue. To 1 m. tall. Leaf-blades flat or somewhat involute, scabridulous. Panicle lax, to 2.5 dm. long (sometimes to 4 dm. ?), axis more or less glabrous, branches and pedicels hispid-scabridulous. Glumes subequal, to 4 mm. long, acute to acuminate, 3-nerved. Lemma about 3-4 mm. long, obovoid, apex broad and truncate without a crown or ciliation, sparsely pilose to almost glabrous. Awn to 2 cm. long, not geniculate, the scabridulous base somewhat loosely twisted, the remainder somewhat flexuose or straight. LA PAZ: LARECAJA: Catarguata, 3000 m., *Mandon* 1270 bis (GH; mixed with *Nassella pubiflora*).

20. **S. Trollii** Pilger in Notizbl. **11:** 777 (1933). To 4-6 dm. tall. Leaf-blades somewhat involute, the upper surface scabridulous.

Panicle to 1.2 dm. long, the axis glabrous. Glumes 5-6 mm. long, lanceolate, the midrib somewhat excurrent. Lemma 4 mm. long, sparsely short-pilose. Awn to 1.5 cm. long, once-geniculate, glabrous. POTOSÍ: PORCO: Salasala-Tasnapalco, 3400 m., *Troll* 3374.

No material of this species has been seen. This description is adapted from the original description.

49. **Aristida** L.

See Caro in Kurtziana, **1:** 123-206 (1961).

Annual or perennial. Leaf-blades flat or involute. Inflorescence a compact to lax panicle. Spikelets 1-flowered, disarticulation above the glumes, the callus sharply pointed. Glumes unequal to equal or subequal. Lemma terete to fusiform, with 3 apical awns, these free to the base or nearly so, or basally united in a short or long twisted column.

a. Callus bidentate at tip. ..... 4. *A. riparia.*
a. Callus entire.
  b. Glumes subequal or equal, or the outer longer than the inner.
    c. Glumes very unequal, the outer about twice the length of the inner. ..... 5. *A. mendocina.*
    c. Glumes subequal or equal.
      d. Leaf-blades involute. ..... 6. *A. enodis.*
      d. Leaf-blades flat (at least at base). ..... 7. *A. circinalis.*
  b. Glumes unequal, the outer shorter than the inner.
    e. Lemma to 3 mm. long. ..... 1. *A. capillacea.*
    e. Lemma to 8-10 mm. long.
      f. Lemma-awns united in a column 2-3 cm. long. ..... 3. *A. implexa.*
      f. Lemma-awns not united in a column.
        g. Longest glumes to 7 mm. long. ..... 2. *A. adscensionis.*
        g. Longest glumes to 1.5 cm. long. ..... 8. *A. laevis.*

1. **Aristida capillacea** Lam. Tabl. Encycl. **1:** 156 (1791). *A. Mandoniana* Henr. in Meded. Rijks Herb. Leiden, no. 40: 55 (1921). Annual to 2 dm. high. Leaf-blades narrow, somewhat involute, scabridulous on upper surface, with a few scattered long hairs near the base. Panicle narrow but rather lax, to 8-10 cm. long, axis and branches glabrous, pedicels glabrous to puberulent. Glumes unequal, the outer shorter, to 4 mm. long, acute, glabrous, the prominent midrib scabridulous. Lemma to 3 mm. long. Awns united basally in a puberulent column, the free portions to 4-5 mm. long, puberulent to scabridulous. LA PAZ: SUR YUNGAS: Guanai, 1600 m., *Rusby* 208 (GH). SANTA CRUZ: SARA: Buenavista, 500 m., *Steinbach* 6140 (GH).

2. **A. adscensionis** L. Sp. Pl. 82 (1753). Caespitose annual, glabrous, the culms branching from the lower nodes, to 3 dm. tall. Leaf-blades involute. Panicle to 1.5 dm. long, compact to spreading, axis, branches

and pedicels usually scabridulous. Glumes unequal, the outer shorter, to 7 mm. long, acute, the midrib scabrous. Lemma to 8 mm. long, the apex long-attenuate, the upper portion puberulent-scabrid. Awns not united basally into a column, to 2 cm. long, the central awn exceeding the laterals, markedly scabrous. COCHABAMBA: CERCADO: Cochabamba, *Hitchcock* 22817 (GH). POTOSÍ: SUR CHICHAS: Villazón, 3500 m., *West* 6368 (GH). LA PAZ: MURILLO: Cotaña, 2450 m., *Buchtien* 208 (GH); Obrajes, 3300 m., *Buchtien* 140 (GH).

3. **A. implexa** Trin. in Mém. Acad. St. Pétersb. VI, Sci. Nat. **2**(1): 48 (1836). Perennial, to 6 dm. tall. Leaf-blades flat or involute, the upper surface densely pilose near the base. Panicle to 2 dm. long, axis, branches and pedicels scabrid. Glumes unequal, the outer much shorter, to 2 cm. long, scabridulous, long-acute. Lemma to 8 mm. long, glabrous, the apex attenuate. Awns united basally into a twisted column to 2-3 cm. long, the free portions to 3-5 cm. long, the central awn longer than the laterals, scabridulous. SANTA CRUZ: SARA: Buenavista, *Steinbach* 5352 (GH), 7029 (GH).

4. **A. riparia** Trin. in Mém. Acad. St. Pétersb. VI, Sci. Nat. **2**(1): 48 (1836). Perennial, caespitose, to 8 dm. high. Leaf-blades flat or involute, rather thick. Panicle to 1.5 dm. long, axis, branches and pedicels scabridulous. Glumes unequal or subequal, the outer longer, awned, to 1.4 cm. long (including the awn), scabridulous, the midrib of the outer glumes prominently so. Lemma to 6 mm. long, glabrous, the callus bidentate at the tip. Awns united basally in a twisted column to 1 cm. long, the free portions equal, to 2 cm. long, scabridulous. LA PAZ: SUR YUNGAS: Chulumani, 1600 m., *Hitchcock* 22702 (GH).

5. **A. mendocina** R. A. Phil. in Anal. Univ. Chile, **36:** 205 (1870). *A. inversa* Hack. in Fries in Ark. Bot. **8**(8): 37 (1908). Perennial, caespitose, to 6 dm. high. Leaf-blades somewhat involute, scabridulous on the upper surface. Panicle lax, narrow, to 2 dm. long, axis, branches and pedicels scabridulous. Glumes very unequal, the first to 11 mm. long, midrib scabrid, the second to 5 mm. long, scabridulous, both glumes often shortly mucronate. Lemma terete to fusiform, somewhat scabridulous on the upper portion, to 9 mm. long. Awns free to the base or nearly so, the central awn to 3 cm. long, the laterals slightly shorter, scabridulous. SANTA CRUZ: SARA: Buenavista, *Steinbach* 1927 (GH).

I have followed Hitchcock in uniting *A. mendocina* and *A. inversa*, but Caro has shown some differences which may warrant at least varietal segregation.

6. **A. enodis** Hack. in Fedde, Rep. Sp. Nov. **11:** 21 (1912). *A. Pflanzii* Mez in Fedde, Rep. Sp. Nov. **17:** 151 (1921). ? *A. Asplundii* Henr. in Meded. Rijks Herb. Leiden, no 54: 42 (1926). Perennial, caespitose, to 4 (-5) dm. tall. Leaf-blades involute, often somewhat scabridulous. Panicle rather dense, often purple, to 10 cm. long.

Glumes equal or subequal, to 1 cm. long. scabrid to nearly glabrous, the scabrid midrib excurrent as a mucro. Lemma narrowly fusiform, to 1 cm. long, glabrous. Awns distinct to the base, to 3 cm. long, minutely scabridulous. LA PAZ: LARECAJA: prope Munaypata, 2700 m., *Mandon* 1277 (GH). SANTA CRUZ: SARA: Buenavista, 400 m., *Steinbach* 6807 (GH).

7. **A. circinalis** Lindm. in Sv. Vet. Akad. Handl. **34**(6): 13 (1900). ? *A. Friesii* Henr. in Meded. Rijks Herb. Leiden, no. 54: 186 (1926). Perennial, caespitose, to 8 dm. tall. Leaf-blades long, flat near the base, becoming involute-filiform, glabrous. Panicle to 2 dm. long, axis, branches and pedicels usually glabrous. Glumes subequal or the outer longer, to 8 mm. long, glabrous, acute, or the midrib excurrent as a mucro. Lemma fusiform, to 7 mm. long, glabrous. Awns subequal, free to base, to 3 cm. long, minutely scabridulous. LA PAZ: SUR YUNGAS: Chulumani, *Hitchcock* 22711 (US).

8. **A. laevis** (Nees) Kunth, Enum. Pl. **1**: 192 (1833). *A. complanata* of the Catalogue. *A. longiramea* var. *boliviana* Henr. in Meded. Rijks Herb. Leiden, no. 40: 56 (1921). Perennial, caespitose, to 7 dm. high. Leaf-blades flat, somewhat scabridulous. Panicle narrow, to 2.5 dm. long; axis, branches and pedicels scabridulous to scabrid. Glumes equal or subequal, the outer shorter, to 1.5 cm. long, aristate or mucronate, the midrib scabrid. Lemma tubular-fusiform, to 1 cm. long. Awns free to base, subequal, about 3 cm. long, scabridulous. SANTA CRUZ: SARA: Buenavista, 500 m., *Steinbach* 5355 (GH).

50. **Tragus** Hall.

Tragus racemosus (L.) All. Fl. Pedem. **2**: 241 (1785). Weedy annual. Stems somewhat geniculate, to 17 cm. high. Leaf-blades flat, lanceolate, to 2.5 cm. long, 6 mm. wide, acute, ciliate. Inflorescence a terminal spike, spikelets 1-flowered, paired, contiguous by flat faces, first glume absent, second glume about 3-4 mm. long, ovate, convex, the margin and three nerves bearing stout hooked spines, lemma and palea thin-textured. LA PAZ: LARECAJA: Sorata, *Mandon* 1268 (GH); NOR YUNGAS: Milluguaya, 1300 m., *Buchtien* 4176 (GH); SUR YUNGAS: Chulumani, 1600 m., *Hitchcock* 22649 (GH).

51. **Aegopogon** Humb. & Bonpl.

Annuals. Culms to 20 cm. long (rarely to 30 cm.), spreading or decumbent. Leaf-blades short, linear, flat, 1-2 mm. wide. Spikelets 1-flowered, pectinately arranged, in groups of 2 or 3, 1 perfect and nearly sessile, the 1 or 2 laterals pedicellate and either staminate or neuter, often purple; glumes narrow, half the length of the lemmas or less, scabridulous, with a rather short delicate awn, lemma with a long central awn and 2 shorter lateral awns, palea with 2 short awns.

Spikelets in groups of 3. ..... 1. *Ae. cenchroides.*
Spikelets in groups of 2. ..... 2. *Ae. bryophilus.*

1. **Aegopogon cenchroides** Humb. & Bonpl. ex Willd. Sp. Pl. **4:** 899 (1806). Leaf-blades scabridulous. Fertile spikelets (excluding the awns) about 3 mm. long. Central awn of lemma to 8 mm. long. LA PAZ: NOR YUNGAS: Unduavi, *Buchtien* 2578 (Hitchcock). COCHABAMBA: CERCADO: Cochabamba, *Hitchcock* 22820 (Hitchcock).

2. **Ae. bryophilus** Doell in Mart. Fl. Bras. **2**(3): 239 (1880). *Ae. geminiflorus* var. *muticus* Pilger in Engler, Bot. Jahrb. **27:** 25 (1899). *Ae. Fiebrigii* **Mez** in Fedde, Rep. Sp. Nov. **17:** 145 (1921). Leaf-sheaths glabrous to scabridulous; blades scabridulous. Fertile spikelets (excluding the awns) about 3 mm. long. Central awn of lemma to 4-6 mm. long. LA PAZ: LARECAJA: Cerro del Iminapi, 2650-3100 m., *Mandon* 1296 (GH); Sorata, *Bang* 1307 (GH; type-number of *Ae. geminiflorus* var. *muticus*). COCHABAMBA: TOTORA: Vacas, 3500 m., *Steinbach* 3965 (GH). TARIJA: ARCE: Camacho, *Fiebrig* 2865 (Hitchcock).

52. **Leptochloa** Beauv.

Annual or perennial, the culms decumbent or erect, 3-8 dm. or even to 1 m. high, leaf-sheaths glabrous, glaucous, scabridulous or even sparsely pilose, blades flat, glabrous to sparsely pilose, rarely equaling or exceeding the mature inflorescence. Inflorescence a terminal, narrow to spreading panicle composed of few to many racemes. Spikelets usually many, few- to many-flowered, unilateral on the rachis, the rachilla disarticulating above the glumes, shortly pedicellate, appressed and somewhat imbricate; glumes unequal to nearly equal, 1-nerved; lemmas broad and notched at apex or acute, sometimes awned or mucronate, 3-nerved, glabrous, or pubescent between the lateral nerves and the margin, at least at the base, the uppermost lemma reduced.

a. Spikelets at least 4 mm. long, usually to 7-9 mm. long.
  b. Lemmas much exceeding the minutely ciliolate palea. ..... 1. *L. uninervia.*
  b. Lemmas about equal to, sometimes exceeded by, the distinctly ciliate palea. ..... 2. *L. dubia.*
a. Spikelets less than 4 mm. long, never to 7-9 mm. long.
  c. Leaf-sheaths and blades glabrous, glaucous or rarely scabridulous, not pilose. ..... 3. *L. virgata.*
  c. Leaf-sheaths and blades not glaucous, sparsely long-pilose. ..... 4. *L. domingensis.*

1. **Leptochloa uninervia** (Presl) Hitchc. & Chase in Contrib. U. S. Nat. Herb. **18:** 383 (1917). Annual. Leaf-sheaths glabrous, blades scabrid. Spikelets (4-) 7-8 mm. long. First glume to 2.5 mm. long, the central nerve carinate and scabrid, acute; second glume 3 mm. long, scabrid on the central nerve, acute, sometimes mucronulate.

Fertile lemmas about 4 mm. long, much exceeding the palea, palea minutely ciliolate. COCHABAMBA: CERCADO: Cochabamba, 2560 m., *Steinbach* 8746 (GH).

2. **L. dubia** (HBK). Nees in Syllog. Pl. Ratisb. **1:** 4 (1824). Perennial. Leaf-blades scabrid. Spikelets to 8-9 mm. long. First glume about 2.5 mm. long; second glume very broad, about 3 mm. long. Fertile lemma to 4-5 mm. long, obtuse, emarginate, with a short central mucro, often pubescent basally between the lateral nerves and the margin. Palea nearly as long as the lemma, occasionally exceeding it, densely ciliate. LA PAZ: MURILLO: Cotaña, 2450 m., *Buchtien* 3136 (GH).

3. **L. virgata** (L.) Beauv. Ess. Agrost. 166 (1812). Perennial. Leaf-sheaths and blades glabrous, glaucous, or rarely both scabridulous. Spikelets 3-3.5 mm. long. First glume about 1.5 mm. long; second glume 2 mm. long, both glumes acute, scabridulous on the central nerve. Lowest fertile lemma about 2.5 mm. long, occasionally the lowest 1 or 2 with short awns, usually the lowest puberulent along the lateral nerves. Palea nearly as long as the lemma, ciliolate. SANTA CRUZ: SARA: Río Surutú, 400 m., *Steinbach* 6834 (GH).

4. **L. domingensis** (Jacq.) Trin. Fund. Agrost. 133 (1820). Perennial. Leaf-sheaths and blades sparsely pilose, not glaucous. Spikelets 2-3.5 mm. long. First glume about 1.5 mm. long; second glume about 2 mm. long. Fertile lemma about 2.5 mm. long, the lowest 1 or 2 awned, the awns to 2 mm. long, margins long-ciliate. Palea somewhat shorter than the lemma, not ciliolate or only faintly so at the apex. LA PAZ: NOR YUNGAS: Coripata, *Hitchcock* 22692 (GH). SANTA CRUZ: SARA: Dolores, 450 m., *Steinbach* 1891 (GH); Buenavista, 450-500 m., *Steinbach* 1179 (GH), 5222 (GH), 6730 bis (GH).

53. **Gouinia** Fourn.

See Swallen in Amer. Journ. Bot. **22:** 31-41 (1935).

Tufted perennials, the culms erect, to 1-1.5 m. high, leaf-sheaths glabrous, leaf-blades scabrid beneath, to 8-14 mm. wide, not equaling the inflorescence. Inflorescence an open racemose panicle. Spikelets few-flowered, the uppermost reduced, in racemes to 15 cm. long, pedicellate; rachilla glabrous; glumes subequal or the second longer, 3-nerved; lemmas longer than glumes, densely villous on the nerves, awned, the awns scabridulous.

Second glume rather obtuse, long-mucronate; panicle-branches bearing spikelets from the base; awn to 1.6 cm. long. ..... 1. *G. brasiliensis.*

Second glume acute, not mucronate; panicle-branches bearing spikelets from the middle upward; awn about 5 mm. long. ..... 2. *G. latifolia.*

1. **Gouinia brasiliensis** (S. Moore) Swallen in Amer. Journ. Bot. **22:** 36 (1935). First glume 4 mm. long; second glume 6 mm. long. Lower

lemmas 7-8 mm. long, the awns to 1.6 cm. long. SANTA CRUZ: CORDILLERA: Puerto Suarez, *Chase* 11151 (GH).

2. **G. latifolia** (Griseb.) Vasey in Contrib. U. S. Nat. Herb. **1:** 365 (1895). Glumes subequal, about 5 mm. long. Lower lemmas 7 mm. long, the awns about 5 mm. long. LA PAZ: NOR YUNGAS: Chulumani, 1600 m., *Hitchcock* 22650 (GH).

54. **Tripogon** Roem. & Schult.

Tripogon spicatus (Nees) Ekman in Ark. Bot. **11**(4): 36 (1912). Densely tufted low perennial. Leaves filiform, glabrous, chiefly basal, much shorter than the culms. Inflorescence a single terminal spike, the entire culm and inflorescence usually less than 25 cm. long (60 cm. in one instance). Spikelets 5-9 mm. long, several- to many-flowered, with more than 1 perfect floret, sessile in 2 rows on the axis but usually appearing unilateral, the rachilla disarticulating above the glumes and between the florets; first glume 2 mm. long or less, subacute, second glume 2.5 mm. long, obtuse; lemmas about 3 mm. long, 3-nerved, the central nerve somewhat carinate and prolonged as a slender awn about 1 mm. long from between 2 small apical teeth, at least the lowermost lemmas with a small basal tuft of hairs; palea hyaline, much shorter than the lemma and enclosed by it. SANTA CRUZ: [province uncertain]: between Río Piray and Río Cuchi, *Herzog* 1449 (Hitchcock).

55. **Eleusine** Gaertn.

Eleusine indica (L.) Gaertn. Fruct. & Sem. **1:** 8 (1788). Weedy annual, the culms ascending to spreading, rarely to 1 m. high, but usually less than 5 dm. Leaves nearly glabrous, the sheaths hirsute near the apex and with a ring of hairs at the apex; leaf-blades flat or folded, to 8 mm. wide, some equaling or exceeding the inflorescence, glabrous. Inflorescence terminal, with 2-5 digitate or subdigitate spikes to 10 cm. long, the spikelets in 2 rows but unilateral on the axis. Spikelets few- to several-flowered, with more than 1 perfect floret below sterile florets, sessile, 3-4 mm. long, the rachilla disarticulating above the glumes and between the florets; glumes awnless, strongly keeled, the keel scabrid, acute, first glume about 2 mm. long, the second glume about 3 mm. long; lemmas strongly keeled, the keels scabridulous, about 3 mm. long; palea bicarinate, the nerves green; caryopsis subglobose to subtrigonous, brown, finely and transversely striate. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5332 (GH); NOR YUNGAS: Polo-Polo, near Coroico, 1100 m., *Buchtien* (in 1912) 238 (GH); Milluguaya, 1300 m., *Buchtien* (in 1917) 238 (GH). SANTA CRUZ: SARA: Río Surutú, 400 m., *Steinbach* 6837 (GH); Buenavista, 500 m., *Steinbach* 5149 (GH), 1871 (GH).

56. **Dactyloctenium** Willd.

Dactyloctenium aegyptium (L.) Willd. Enum. Hort. Berol. 1029 (1809) [as *aegyptiacum*]. Weedy, rather pilose annual, spreading by stolons and forming mats, culms erect, to 6 dm. high, leaf-sheaths glabrous or nearly so, the flat leaf-blades pilose and ciliate, shorter than the inflorescence. Inflorescence terminal, of 2-5 digitately arranged spikes 2-5 cm. long, the rachis exceeding the spikelets as a short subulate point, spikelets in 2 rows, unilateral on the axis. Spikelets several-flowered, sessile, imbricate, about 9 mm. long, the rachilla disarticulating above the glumes and between the florets; first glume about 3 mm. long, 1-nerved, acute, the second glume longer, with a short scabridulous awn arising from below the apex; lemma about 6 mm. long, 3-nerved, the central nerve keeled, scabridulous, the apex acuminate to short-awned; palea a little shorter than the lemma; caryopsis nearly globose, wrinkled or ridged. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 3132 (GH).

57. **Cynodon** L. Rich.

Cynodon Dactylon (L.) Pers. Synops. Pl. **1:** 85 (1805). Low perennial, the stolons spreading extensively and rooting at the nodes, the culms produced at the nodes, with a few basal leaves, the sheaths glabrous, the short (2-3 cm.) blades scabridulous, the culms clothed in leaf-sheaths with greatly reduced free tips; fertile culms 10-40 cm. high. Inflorescence terminal, digitate, 3-6 spikes to 5 cm. long, the sessile spikelets in 2 rows along the axis, unilateral, imbricate. Spikelets 1-flowered, the rachilla disarticulating above the glumes and produced as a slender bristle behind the palea; glumes almost equal, to 3 mm. long, or the first glume shorter than the second, narrow, strongly keeled, the keel scabrid; lemma awnless, to 3 mm. long or a little longer, usually somewhat exceeding the second glume, naviculate, brown-hyaline, the central keel prominent and densely pubescent, the margins long-ciliate; palea somewhat shorter than the lemma. SANTA CRUZ: CERCADO: playa del Río Piray, 450 m., *Steinbach* 3246 (GH).

58. **Microchloa** R. Br.

Microchloa indica (L. f.) Beauv. Ess. Agrost. 13 (1812). Tufted annual, usually low in stature but sometimes the erect culms to 25 cm. high, leaves glabrous, the very narrow blades flat or folded, not equaling the inflorescence. Inflorescence a solitary terminal spike to 10 cm. long, the axis bifariously puberulent on the side toward the spikelets, the spikelets unilateral on the axis. Spikelets 1-flowered, about 3 mm. long, sessile or subsessile; disarticulation above the glumes; glumes subequal, 2.5 mm. long, 1-nerved, acute; lemma and

palea subequal, about 2 mm. long, acute, hyaline, the upper portion more or less densely covered by a long silky pubescence; caryopsis brown, subtrigonous, finely reticulate-striate. LA PAZ: MURILLO: La Paz, 3600 m., *Buchtien* 3130 (GH); Obrajes, 3450 m., *Buchtien* 9132 (GH).

59. **Gymnopogon** Beauv.

Loosely tufted perennials, the slender culms erect or spreading, 3-8 dm. high, leaves glabrous, the blades 2-5 cm. long and 2-5 mm. wide, reduced upward on the culm, never equaling nor exceeding the inflorescence. Inflorescence a terminal panicle of slender racemes 5-25 cm. long. Spikelets many, pedicellate, with 1-2 perfect florets below 1-3 sterile florets, rachilla disarticulating above the glumes; glumes subequal; fertile lemma long-awned, more or less terete.

Racemes to 5 cm. long, collected near the apex of the culm; spikelet 2-flowered. ..... 1. *G. jubiflorus.*

Racemes 10-25 cm. long, distant along the main axis; spikelet 1-flowered, with 1-2 much reduced florets. ..... 2. *G. spicatus.*

1. **Gymnopogon jubiflorus** Hitchc. in Contrib. U. S. Nat. Herb. **24:** 412 (1927). Glumes subequal, the second slightly longer than the first, 3.5-4 mm. long, lance-acuminate. Fertile lemma about 2 mm. long with an apical tuft of hairs to 1.5 mm. long, the awn about 8 mm. long. Palea about as long as the lemma. LA PAZ: LARECAJA: Guanay, *Rusby* 215 (US; type).

2. **G. spicatus** (Spreng.) O. Ktze. Rev. Gen. **3**(2): 354 (1898). First glume 3.5 mm. long; second glume 4 mm. long. Fertile lemma very narrow, 2.5 mm. long, apical hairs very short, awn 8-10 mm. long. SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 1932 (GH), 2357 (GH), 5386 (GH), 6977 (GH).

60. **Chloris** Swartz

Annual or perennial, with decumbent to erect culms 2 dm. to 1 m. high, leaves glabrous or scabrid or sparsely pilose, the short blades to 1 cm. wide, not equaling the inflorescence. Inflorescence terminal, composed of digitately arranged spikes in 1 or 2 whorls, the sessile spikelets unilaterally arranged. Spikelets with 1 perfect floret below 1-2 (-3) reduced and rudimentary florets, rachilla disarticulating above the glumes; glumes unequal, lemmas mucronulate or awned (awnless in no. 1).

a. Lemmas awnless. ..... 1. *C. distichophylla.*

a. Lemmas awned or mucronulate.

b. Fertile lemmas not villous on keel (sometimes sparsely villous above), nor ciliate; sterile floret narrow, acute at apex.

c. Spikelets about 5 mm. long; fertile lemma 3-5 mm. long.

d. Spikes 6-10, 5-8 cm. long. ..... 4. *C. Beyrichiana.*

d. Spikes 6-15, 7-15 cm. long. ..... 5. *C. halophila.*

c. Spikelets about 3 mm. long; fertile lemma about 2 mm. long. ..... 6. *C. radiata.*

b. Fertile lemmas villous on keel, at least on lower half (rarely glabrous), margins ciliate; sterile floret broad and truncate at the apex.

e. Lemma long-ciliate from base to apex, the hairs 3 mm. long; perennial. ..... 2. *C. polydactyla.*

e. Lemma only shortly ciliate, or glabrous at base, the hairs increasing in length upward, the keel rarely glabrous; annual. ..... 3. *C. virgata.*

1. **Chloris distichophylla** Lag. Gen. & Sp. Nov. 4 (1816). Perennial. Spikelets about 3 mm. long. First glume somewhat less than 2 mm. long, 1-nerved, acute; second glume about 2.5 mm. long, 1-nerved, often mucronulate. Fertile lemma about 3 mm. long, mucronulate, the margin ciliate with long hairs decreasing in length upward. Palea shorter than the lemma. Sterile lemma shorter than the fertile, glabrous, obtuse at apex but not broadest at apex. LA PAZ: Yungas, *Bang* 267 (GH); NOR YUNGAS: Polo-Polo, near Coroico, 1100 m., *Buchtien* 228 (GH); SUR YUNGAS: Chulumani, 1600 m., *Hitchcock* 22663 (GH). SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 5359 (GH), 6867 (GH).

2. **C. polydactyla** (L.) Swartz, Prodr. 26 (1788). Spikelets to 3.5 mm. long. First glume about 2.5 mm. long, the single nerve scabridulous; second glume about 3.5 mm. long, the central nerve scabrid. Fertile lemma about 2.5 mm. long, with a 3.5 mm. awn. LA PAZ: NOR YUNGAS: Milluguaya, 1300 m., *Buchtien* 739 (GH); Coripata, *Hitchcock* 22689 (GH).

3. **C. virgata** Swartz, Fl. Ind. Occ. 1: 203 (1797). Spikelets about 4 mm. long. First glume 2 mm. long; second glume 4 mm. long, mucronulate to short-awned. Fertile lemma about 3 mm. long, the awn about 1.1 cm. long. Palea about 3 mm. long, the 2 nerves lateral and ciliolate. COCHABAMBA: CERCADO: Valle de Cochabamba, 2600 m., *Steinbach* 8796 (GH).

4. **C. Beyrichiana** Kunth, Rév. Gram. 1: 289 (1830). Perennial. Spikelets about 5 mm. long. First glume 3 mm. long, long-acute, the nerve scabridulous; second glume about 4.5 mm. long, long-acute, the nerve scabridulous. Fertile lemma about 4.5 mm long, strongly bidentate, the awn to 1.7 cm. long. Palea shorter than lemma, densely ciliolate. LA PAZ: MURILLO: La Paz, 3300 m., *Bang* 82 (GH). COCHABAMBA: MIZQUE: Vilavila, 2500 m., *Eyerdam* 24987 (GH). TARIJA: CERCADO: Tarija, 2000 m., *Cárdenas* 200 (GH).

5. **C. halophila** L. R. Parodi in Revist. Argent. Agron. 12: 45 (1945). Perennial. Spikelets 5-6 mm. long. First glume 2.5 mm. long; second glume 4-4.5 mm. long. Fertile lemma about 5-5.5 mm.

long, bidentate, the awn 2 cm. long, the margins sparsely ciliate above. LA PAZ: MURILLO: Obrajes, 3400 m., *Buchtien* 573 (GH).

The original description cited several collections from the departments of Cochabamba and Tarija. I have not seen these.

6. **C. radiata** (L.) Swartz, Prodr. 26 (1788). Annual. Spikelets about 3 mm. long, but sometimes up to 5 mm. First glume about 1.5 mm. long; second glume about 3 mm. long, long-acute to very shortly awned, margins sparsely ciliate above. Palea as long as the lemma, bidentate. LA PAZ: NOR YUNGAS: near Coripata, 1700 m., *Buchtien* 8056 (GH), *Bang* 2173 (GH).

61. **Trichloris** Fourn.

Tufted perennials, the erect culms to 1 m. high, usually shorter, leaves scabrid on sheaths and blades, blades 2-10 mm. wide, not exceeding the inflorescence. Inflorescence a group of terminal spikes 5-15 cm. long. Spikelets 2-5-flowered, fertile florets below the sterile, the rachilla disarticulating above the glumes, subsessile, in 2 rows, unilateral on the rachis; first glume shorter than the second, mucronate or shortly awned; lemmas with a tuft of hairs at the base, 1-3-awned, all awns scabridulous.

Leaf-blades to 4 mm. wide; lemmas 3-awned, the awns all long; spikelets 2-flowered, the upper floret much reduced; inflorescence dense. ..... 1. *T. mendocina.*

Leaf-blades to 10 mm. wide; lemmas with lateral awns much reduced or obsolete; spikelets 3-5-flowered, the uppermost much reduced; inflorescence much more open. ..... 2. *T. pluriflora.*

1. **Trichloris mendocina** (Phil.) Kurtz in Mem. Fac. Cienc. Exact. Univ. Córdoba, **1897:** 37 (1897). Spikelet about 3-4 mm. long (excluding the awns). First glume about 1 mm. long, very narrow, the awn 1.5 mm. long; second glume 2 mm. long, the awn 3 mm. long. Lowest lemma to 4 mm. long, pubescent on the upper portion, awns to 1.2 cm. long. SANTA CRUZ: CERCADO: Mataral, *Herzog* 1804 (Hitchcock).

2. **T. pluriflora** Fourn. Mex. Pl. **2:** 142 (1886). Spikelet about 6 mm. long (excluding the awns). First glume about 1.5 mm. long, the awn much shorter; second glume about 2.5 mm. long, the awn about 0.5 mm. long. Lowest lemma 4 mm. long, ciliate, awns about 6 mm. long. SANTA CRUZ: VALLEGRANDE: Comarapa, *Herzog* 1928 (US).

62. **Bouteloua** Lag.

See Griffiths in Contrib. U. S. Nat. Herb. **14:** 343-428 (1912).

Annual or perennial, the culms erect or decumbent, mostly 10-20 cm. high, occasionally to 1 m. high, leaves generally glabrous, sometimes sparsely hirsute near the edge of the sheath and on the base

of the blade, always shorter than the inflorescence, the blade narrow. Inflorescence terminal, a solitary spike or few to many short racemose spikes. Spikelets sessile, 1-flowered, with a rudimentary floret above the perfect one, unilaterally arranged; glumes present, unequal; fertile lemma 3-5-toothed, awned or awnless.

a. Spike 1, persistent, the spikelets falling separately. ..... 1. *B. simplex.*
a. Spikes few to several, each spike falling entire.
  b. Awns 2-3 cm. long. ..... 2. *B. megapotamica.*
  b. Awns much shorter.
    c. Spikes at maturity erect or spreading; rachis sharply pointed at base and retrorsely bearded. ..... 3. *B. aristidoides.*
    c. Spikes at maturity deflexed, rachis-base neither pointed nor bearded. ..... 4. *B. curtipendula.*

1. **Bouteloua simplex** Lag. in Varied. Cienc. **29**(4): 141 (1805). Annual. First glume 3.5 mm. long, faintly 1-nerved; second glume to 5 mm. long, acute, strongly 1-nerved. Fertile lemma with a tuft of hairs at base, to 3 mm. long, the central awn 3 mm. long, sparsely pilose at base and along midrib. LA PAZ: MURILLO: La Paz, 3300 m., *Bang* 81 (GH); LARECAJA: vic. Sorata; Lorecasa, 2650-3200 m., *Bang* 81 (GH); LARECAJA: vic. Sorata; Lorecasa, 2650-3200 m., *Mandon* 1325 (GH). POTOSÍ: CERCADO: Potosí, 4000 m., *Cárdenas* 197 (GH). TARIJA: AVILES: Puna Patanca, 3700 m., *Fiebrig* 2629 (GH).

2. **B. megapotamica** (Spreng.) O. Ktze. Rev. **3**(2): 341 (1898). Perennial. Spikelet with basal tufts of hairs. First glume 3 mm. long with a 3 mm. awn, 1-nerved; second glume 7 mm. long with a 3 mm. awn, very strongly 1-nerved. Fertile lemma 4 mm. long with the central awn 1 cm. long. Palea longer than the lemma, bidentate. Reduced florets with awns to 3 cm. long. TARIJA: ARCE: Padcaya, 2100 m., *Fiebrig* 2552 (GH).

3. **B. aristidoides** (HBK.) Griseb. Fl. Brit. W. Ind. 537 (1864). Annual. First glume 2.5 mm. long, acute, 1-nerved; second glume 7 mm. long, puberulent at base, scabridulous above, awnless. Fertile lemma about 6 mm. long, glabrous, awnless. Palea as long as lemma, bidentate. Awns of sterile lemmas to 6 mm. long. TARIJA: Gran Chaco, *Fries* 1691 (Hitchcock).

4. **B. curtipendula** (Michx.) Torr. in Marcy, Red River Rept. 300 (1853). Perennial, the culms up to 1 m. high. First glume 3 mm. long, attenuate into a 2 mm. awn, the prominent central rib hispidulous; second glume 7 mm. long, awnless, bidentate, with a short point between the teeth, scabridulous near the margin and on the prominent central nerve. Fertile lemma about 6 mm. long, glabrous below, scabridulous above and on the 3 long teeth. Palea as long as lemma, bidentate, the upper half scabridulous. LA PAZ: LARECAJA: Sorata, *Mandon* 1380 (GH). COCHABAMBA: CERCADO: west of Cochabamba, 2700 m., *Eyerdam* 24875 (GH). TARIJA: ARCE: Padcaya, *Fiebrig* 3281 (GH), 3282 (GH).

63. **Munroa** Torr.

See L. R. Parodi in Revist. Mus. La Plata, **34:** 171-193 (1934).

Low-growing, more or less tufted, spreading annuals, 2-15 cm. high, the leaves very short, the sheaths very broad, blades a few cm. long, the apex pungent. Inflorescence condensed into heads or glomerules, these more or less concealed by the sheaths of the fascicled subtending leaves. Spikelets aggregated in groups of 2 or 3, the lower 3-4-flowered, the upper 2-3-flowered, the first floret in the spikelet perfect, the others sterile, usually 3 groups in a cluster, the rachilla disarticulating above the glumes; glumes usually quite unequal; lemmas 3-nerved, the nerves much or little prolonged as awns or mucros. Caryopsis dorsally compressed.

a. Lowest fertile lemma 4-lobed with 3 awns, the central awn longest; back of lemma with 2 tufts of hairs below the central sinus of the lobes; 2 central lobes broader than the 2 lateral, the former rather obtuse, the latter acute; margins long-ciliate for over half their length; palea with puberulent nerves. ..... 1. *M. andina.*

a. Lowest fertile lemma 2-3-toothed, the central tooth narrower than the laterals, its apex subaristate, the laterals mucronulate; palea glabrous.

b. Lowest lemma papery at base, 2-toothed with a central awn, the back with 2 tufts of hairs, the margin long-ciliate below or above the middle, the hairs reaching neither apex nor base; palea broadest at apex. ..... 2. *M. decumbens.*

b. Lowest fertile lemma coriaceous at base, 3-toothed; dorsal tufts of hairs absent, the margin long-ciliate above the middle; palea broadest at the base. ..... 3. *M. argentina.*

1. **Munroa andina** Phil. in Anal. Mus. Nac. Chile, **8:** 90 (1891). Leaf-blades about 1 cm. long, 1 mm. wide. Glumes unequal, the second to 4 mm. long, mucronulate. Lowest lemma about 3.5 mm. long. LA PAZ: PACAJES: Calacota, 3800 m., *Asplund* 2653.

1a. **M. andina** var. **breviseta** Hack. ex Stuckert in Ann. Conserv. & Jard. Bot. Genève, **17:** 294 (1914). This variety is distinguished by the lowest lemma with very short awns, hardly, if at all, exceeding the lemma-lobes. LA PAZ: PACAJES: Charaña, 4050 m., *Asplund* 2691.

2. **M. decumbens** Phil. in Anal. Mus. Nac. Chile, **8:** 90 (1891). Leaf-blades to 2.5 cm. long and 2 mm. wide. Glumes unequal, the second to 4.5 mm. long. Lowest lemma about 4 mm. long, with a 3 mm. central awn between the 2 lobes. POTOSÍ: NOR LIPEZ: Chiguana, 3700 m., *Asplund* 6504 (US); PORCO: Uyuni, 3700 m., *Asplund* 6487 (US).

3. **M. argentina** Griseb. in Goett. Abh. **24:** 300 (1879). Leaf-blades 2 cm. long, 1 mm. wide. Glumes subequal, about as long as the lowest lemmas. Lowest lemma to 5 mm. long. POTOSÍ: SUR CHICHAS: Atocha,

3700 m., *Asplund* 6485 (US). CHUQUISACA: SUR CINTI: Camataquí, 2500 m., *Fiebrig* 2801.

With three exceptions, all specimen-citations have been taken from Parodi's treatment of the genus.

64. **Phalaris** L.

Annuals, the culms erect. Leaf-blades linear, flat, acute, from much shorter than to exceeding the inflorescence, to 6 mm. wide. Inflorescence a terminal spicate panicle. Spikelets strongly flattened, densely imbricate, the perfect floret terminal with 2 sterile lemmas below it, all concealed by the glumes; disarticulation above the glumes; glumes papery white with green stripes, the green keel broadly winged, or narrowly winged near the acute apex; sterile lemmas one-half to one-third as long as the appressed-pubescent coriaceous fertile lemma, the bicarinate palea enclosed by the fertile lemma.

Culms 3-6 dm. tall, inflorescence ovate, broad, to 5 cm. long or less; glumes broadly winged, 7-8 mm. long, sparsely long-hirsute, the hairs usually appressed. ..... 1. *P. canariensis.*
Culms 1-1.5 m. tall, sometimes shorter; inflorescence narrowly cylindric, 6-15 cm. long; glumes not winged or only narrowly so, especially near the apex, 3.5-4 mm. long, shortly ciliolate on keel and 2 chief nerves. ..... 2. *P. angusta.*

1. **Phalaris canariensis** L. Sp. Pl. 54 (1753). LA PAZ: MURILLO: La Paz, *Buchtien* 239 (Hitchcock); NOR YUNGAS: Coroico, *Buchtien* 3641 (Hitchcock).

2. **P. angusta** Nees ex Trin. Gram. Icon. 1: t. 78 (1827). LA PAZ: LARECAJA: Sorata, *Mandon* 1246 (Hitchcock).

65. **Leersia** Swartz

Leersia hexandra Swartz, Prodr. 21 (1788). Perennial, often subaquatic, scabrous or scabridulous, many culms decumbent, rhizomes slender and producing leafy stolons, fertile culms erect, sometimes to 2 m. tall, usually shorter. Leaf-blades narrow, linear-lanceolate, to 15-20 cm. long and 5 mm. wide, long-acute. Inflorescence a narrow panicle to 15 cm. long, the branches appressed. Spikelets solitary, 1-flowered, the floret perfect, disarticulating from the very short pedicel, strongly flattened, glumes lacking, lemma and palea similar in appearance, to 4-5 mm. long, often pinkish or purplish, subequal in length and width, oblong to narrowly ovate, acute, with 3 prominent ribs, these often hispidulous or the entire lemma hispidulous, the margins coarsely ciliate. SANTA CRUZ: SARA: playa del Río Perdix, 450 m., *Steinbach* 7453 (GH); Buenavista, 450 m., *Steinbach* 2180 (GH), 7116 (GH).

66. **Luziola** Juss.

Luziola peruviana Gmel. Syst. Nat. **1:** 637 (1791). Perennial, usually of wet or muddy areas or even in water, the slender culms to 40 cm. long, but usually much shorter, often decumbent, branching, fertile culms erect. Leaf-blades more or less linear, long-acute, to 30 cm. long, usually much shorter, 1-4 mm. wide, exceeding the inflorescences. Spikelets 1-flowered, unisexual, disarticulating from the filiform pedicels, pistillate and staminate spikelets in separate panicles on the same plant, the staminate panicles terminal, the pistillate terminal and axillary, both short, to 6 cm. long; pistillate spikelets 2-3 mm. long, the stigmas long-plumose, the staminate spikelets 4-7 mm. long; glumes absent in both; lemma and palea similar in appearance and subequal, thin-textured, with several to many nerves, the nerves obten scabridulous; caryopsis globose, rather shiny, finely striate, about 1 mm. long or longer, sometimes shortly beaked with the persistent base of the style. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 1946 (GH), 6811 (GH). TARIJA: ARCE, La Merced, near Bermejo, 1700 m., *Fiebrig* 2189 (GH).

67. **Pharus** L.

Perennials, often in wet places, the culms to 1 m. high, solitary and erect, or creeping at the base and rooting at the basal nodes, forming mats. Leaf-blades petiolate, the petiole once-twisted, elliptic-oblong or lanceolate, the principal veins connected by numerous and obvious small parallel cross-veins. Inflorescence a reduced to expanded small panicle; spikelets 1-flowered, appressed, paired, the small staminate spikelet pedicellate, the pistillate subsessile; 2 glumes present, dark-brown; disarticulation above the glumes; lemma terete, much exceeding the glumes, somewhat indurate, beaked, entirely or partially pubescent, the hairs somewhat uncinate, the margins incurved and concealing the palea.

a. Lemma entirely pubescent.
   b. Culms creeping at base and forming mats; inflorescence usually reduced and few-branched. ..... 3. *P. parvifolius.*
   b. Culms erect, solitary; inflorescence larger and more open. ..... 1. *P. glaber.*
a. Lemmas pubescent only near the beak. ..... 2. *P. latifolius.*

1. **Pharus glaber** HBK. Nov. Gen. & Sp. **1:** 196 (1816). Spikelets about 1 cm. long, about twice the length of the glumes. Leaf-blades to 25 cm. long and 5 cm. wide, abruptly short-acuminate. LA PAZ: NOR YUNGAS: Milluguaya, 900 m., *Buchtien* 4173 (GH).

2. **P. latifolius** L. Syst. Nat. (ed. 10) **2:** 1269 (1759). Spikelets 1.5-2 cm. long, exceeding, but seldom twice the length of, the glumes. Leaf-blades generally broader. No Bolivian material which is un-

questionably this species has been seen, but it seems probable that the species will be found there.

3. **P. parvifolius** Nash in Bull. Torr. Bot. Club, **35:** 301 (1908). Spikelets less than 1.5 cm. long. Leaf-blades generally broadest below the middle, sometimes long-acuminate. LA PAZ: SUR YUNGAS: Covendo, *White* (M. E.) 1043 (Hitchcock).

68. **Arundinella** Raddi

Tufted perennials, the erect culms from 1-2.5 m. high. Leaf-sheaths glabrous; leaf-blades shorter than or equaling the inflorescence, to 5 mm. wide, hirsutulous to scabrid along the nerves, or glabrous. Inflorescence a rather dense panicle, the pedicellate spikelets solitary. Spikelets 2-flowered, the lower floret staminate or sterile, the upper pistillate; first glume much shorter than the second, the apices divergent and often somewhat acuminate, strongly 3-nerved, the second glume at least twice the length of the sterile and fertile lemmas, or equal to the sterile lemma; disarticulation above glumes; fertile lemma shortly villous on the basal callus, scabridulous, bearing a geniculate awn about 1 cm. long or less, completely enclosing the palea.

Culms to 2.5 m. high; inflorescence-branches and pedicels densely and retrorsely scabridulous; glumes 2-2.5 mm. long; lemmas 2-2.5 mm. long; awn basally twisted, about 2 mm. long. ..... 1. *A. confinis.*

Culms usually less than 1 m. high; inflorescence-branches and pedicels glabrous to faintly scabridulous; glumes 3-5 mm. long; lemmas 1.5 mm. long; awn about 1 cm. long, not twisted basally. ..... 2. *A. Berteroniana.*

1. **Arundinella confinis** (Schult.) Hitchc. & Chase in Contrib. U. S. Nat. Herb. **18:** 290 (1917). SANTA CRUZ: SARA: Buenavista, *Steinbach* 6888 bis (GH).

2. **A. Berteroniana** (Schult.) Hitchc. & Chase in Contrib. U. S. Nat. Herb. **18:** 290 (1917). LA PAZ: LARECAJA: Mapiri, *Buchtien* 1175; SUR YUNGAS: Covendo, *White* (M. E.) 995. BENI: YACUMA; Rurrenabaque, *Cárdenas* (M. E.) 1166. Citations from Hitchcock.

69. **Trichopteryx** Nees

Trichopteryx flammida (Trin.) Benth. ex Jacks. & Hook. f. Index Kew. 4: 1109 (1895). Tufted perennial, the culms 1.5-2 m. high. Leaf-sheaths glabrous to hirsute; leaf-blades sometimes exceeding the inflorescence, flat, to 7 mm. wide. Inflorescence terminal, a rather dense panicle, to 60 cm. long, the spikelets solitary, pedicellate, the pedicels bearing a few long hairs at the apex. Spikelets 2-flowered, the lower floret staminate, glabrous and awnless, the upper floret pistillate; first glume 4-5 mm. long, strongly 3-nerved, the nerves ciliolate, with 3-5 erect hairs 3-4 mm. long near the apex, second

glume 4-5 mm. long, less strongly nerved, glabrous; disarticulation above the glumes; lemma of staminate floret about 6 mm. long, glabrous, nearly twice the length of the hyaline palea; lemma of pistillate floret 3-4 mm. long, densely long-pubescent, bearing a scabridulous awn up to 2 cm. long, this geniculate shortly above its base. LA PAZ: LARECAJA: San Carlos, Mapiri, 850 m., *Buchtien* 9 (GH). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 1884 (GH), 5358 (GH), 6958 (GH).

The authorship of this combination is often given as Bentham in Journ. Linn. Soc. Bot. 19: 59 (1882), but examination shows that the combination was not actually made there. It was merely implied.

70. **Tristachya** Nees

Tristachya chrysothrix Nees, Agrost. Bras. 460 (1829). Tufted perennial, the culms to 1 m. high, the leaf-sheaths hirsute to hispidulous or glabrous. Leaf-blades flat to involute, hirsute to almost glabrous, not exceeding the inflorescence, to 4 mm. wide (when flattened). Inflorescence a lax, nearly simple panicle, the branches puberulent to glabrous below, hirsute above, the hairs golden-brown, spikelets sessile in groups of 3, terminal on the branches. Spikelets 2-flowered, the lower floret staminate and awnless, the upper floret pistillate; first glume about 1 cm. long, 3-nerved, each lateral nerve with a row of short, dark brown tubercles, each bearing a long golden-brown hair, second glume to 1.5 cm. long, pubescent along the margins in the upper portion; disarticulation above the glumes; lemmas of staminate floret glabrous, about 1.2 cm. long, the palea 2-nerved, ciliate; lemma of pistillate floret about 7 mm. long, densely pubescent, the base surrounded by longer, white, silky hairs, bearing a twisted awn 4-7 cm. long, rising between 2 slender teeth, the lower portion brown and hispidulous, the upper portion green and more nearly scabridulous. SANTA CRUZ: VALLEGRANDE: Samaipata, 2000 m., *Steinbach* 3772 (GH).

71. **Leptocoryphium** Nees

Leptocoryphium lanatum (HBK.) Nees, Agrost. Bras. 84 (1829). Perennial, to 1 m. high. Leaves glabrous, the blades flat or often involute, to 3 mm. wide, linear. Inflorescence a rather lax, narrow, racemose, terminal panicle, the rachis, branches and pedicels glabrous. Spikelets 2-flowered, the lower floret a sterile lemma, the other perfect, disarticulation below the glumes. First glume absent; second glume to nearly 5 mm. long, strongly several-nerved, long-pilose, the hairs mostly confined to the nerves. Sterile lemma as long as the glume and similar in appearance and pilosity. Fertile lemma about as long

as the sterile, thin-textured, the margins sparsely ciliate, the apex slightly erose-fimbriate. Palea nearly as long as the fertile lemma, thin, not carinate. LA PAZ: LARECAJA: Hacienda Casana, 1600 m., *Buchtien* 7146 (GH). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 3269 (GH), 6639 (GH), 6640 (GH).

72. **Trichachne** Nees

Perennials, the bases somewhat swollen and felty-pubescent or scaly. Leaf-sheaths glabrous or papillate-hirsute; leaf-blades glabrous or scabridulous. Inflorescence a panicle of shortish racemes. Spikelets paired, pedicellate, 2-flowered, the lower floret a sterile lemma, the upper floret perfect, silky-villous; disarticulation below the glumes. Glumes very unequal; second glume and sterile lemma similar and subequal; fertile lemma firm-textured and acuminate; palea similar but narrower.

a. Sterile lemma silky-villous dorsally. ..... 1. *T. insularis.*
a. Sterile lemma glabrous dorsally.
  b. Leaf-sheaths glabrous; blades to 7-8 mm. wide; fertile lemma about 3 mm. long. ..... 2. *T. sacchariflora.*
  b. Leaf-sheaths sparsely papillate-hirsute (at least when young); blades to 5 mm. wide, glabrous to puberulent; fertile lemma 2.5 mm. long. ..... 3. *T. californica.*

1. **Trichachne insularis** (L). Nees, Agrost. Bras. 86 (1829). Plants to 1.5 m. tall. Leaf-sheaths rather sparsely papillate-hirsute; leaf-blades to 1.5 cm. wide, scabridulous above. Panicle to 3 dm. long, the racemes to 15 cm. long, tawny when mature. Spikelets to 4 mm. long. First glume over 0.5 mm. long, obtuse; second glume 3 mm. long, acute, silky-villous. Sterile lemma 4 mm. long, not glabrous dorsally. Fertile lemma 3.5 mm. long. LA PAZ: NOR YUNGAS: Milluguaya, 1200 m., *Buchtien* 4188 (GH). COCHABAMBA: CHAPARE: Antahuacana, Espíritu Santo, 750 m., *Buchtien s. n.* (GH).

2. **T. sacchariflora** (Raddi) Nees, Agrost. Bras. 87 (1829). *T. affinis* Swallen in Rhodora, **65:** 355 (1963). Plants to 8 dm. tall. Leaf-sheaths glabrous; leaf-blades to 7-8 mm. wide, glabrous. Panicle to 20 cm. long, the racemes often more than 5 cm. long. Spikelets about 3-4 mm. long, silky-villous, the hairs white to purplish. First glume less than 0.5 mm. long, apex broadly truncate and usually erosulous, glabrous; second glume as long as the spikelet, acute, the hairs basal, marginal and on the nerves. Sterile lemma as long as the spikelet, acute, apically somewhat lanate-penicillate, the remaining hairs between the margins and the marginal nerves. Fertile lemma about 3 mm. long, longitudinally striatulate. LA PAZ: LARECAJA: San Carlos, Mapiri, 850 m., *Buchtien* 31 (GH). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 6638 (GH), 6876 (GH); Dolores, 450 m., *Steinbach* 1911 (GH).

3. **T. californica** (Benth.) Chase in Journ. Wash. Acad. Sci. **23:**

455 (1933). *T. saccharata* of the Catalogue. Plants 4-10 dm. tall. Leaf-sheaths glabrous to sparsely papillate-pilose; leaf-blades to 5 mm. wide, glabrous to puberulent. Panicle to 10 (-15) cm. long, racemes few, mostly to 5 cm. long. Spikelets about 3-3.5 mm. long, mostly obscured by the long white hairs. First glume about 0.5 mm. long, truncately obtuse to subacute. Sterile lemma as long as the spikelet, 3-nerved, densely villous between the marginal nerves and the margin, glabrous dorsally. Fertile lemma 2.5 mm. long, glabrous, finely striatulate. COCHABAMBA: CERCADO: Cochabamba, *Holway* 321 (Hitchcock), 368 (Hitchcock).

73. **Digitaria** Heister

See Henrard, J. Th. Monograph of the Genus Digitaria. Leiden, 1950.

Annuals or perennials, the culms 0.4-1 m. tall. Leaf-sheaths and blades often papillate-hirsute, the blades sparsely so, to glabrous or glabrate. Inflorescence a panicle of racemes, these digitate, subdigitate, solitary or irregularly arranged along the axis. Spikelets 2-flowered, the lower floret a sterile lemma, pedicellate in groups of 2 or 3, unilateral, in 2 rows. Glumes very unequal, the first glume minute or wanting; second glume and sterile lemma similar. Fertile lemma firm-textured and somewhat pitted-striatulate.

a. First glume present, minute.
  b. Spikelets about 3 mm. long (2.5-3.5); rachis of inflorescence without hispid hairs. ..... 1. *D. adscendens.*
  b. Spikelets 2 mm. long; rachis with sparse, long, hispid hairs, especially at the nodes. ..... 2. *D. horizontalis.*

a. First glume absent.
  c. Spikelets 1.5 mm. long, or less. ..... 3. *D. violascens.*
  c. Spikelets 2.5 mm. long.
    d. Second glume obtuse, shorter than the dark brown fruit. ..... 4. *D. leiantha.*
    d. Second glume acute, longer than the pale fruit. ..... 5. *D. lanuginosa.*

1. **Digitaria adscendens** (HBK.) Henr. in Blumea, **1**: 92 (1934). Weedy annual, decumbent and spreading, the culms to 1 m. long but usually much shorter. Leaf-sheaths papillate-hirsute; leaf-blades to 1 cm. wide, pubescent to glabrous. Racemes to 10 (-15) cm. long, the rachis 0.5 mm. wide, with margins as wide as the central rib, digitate or in several whorls. First glume less than 0.5 mm. long; second glume about 1.5 mm. long, ciliate. Sterile lemma acute, 3-nerved, pubescent along the nerves but mostly between the lateral nerves and the margins. Fertile lemma about 3 mm. long, light in color and finely pitted. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5318 (GH); NOR YUNGAS: Polo-Polo, near Coroico, 1100 m., *Buchtien* (in 1912) 444 (GH); Milluguaya, 1300 m., *Buchtien* (in

1917) 444 (GH). SANTA CRUZ: SARA: Río Surutú, 400 m., *Steinbach* 6839 (GH); Buenavista, 450 m., *Steinbach* 6848 (GH), 7057 (GH).

2. **D. horizontalis** Willd. Enum. Pl. 92 (1809). Annual. Leaf-sheaths usually papillate-hirsute; blades to 1 cm. wide, densely pubescent. Raceme-rachis almost without a margin, with scattered, long, hispid hairs, these prominent at the nodes. Spikelets 2 mm. long. First glume minute; second glume about 1 mm. long, subacute, ciliate on upper margin. Sterile lemma 2 mm. long, puberulent near the margin. Fertile lemma pale, acute, shorter than the sterile lemma. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 6986 (GH).

3. **D. violascens** Link, Hort. Berol. 1: 229 (1927). Annual, decumbent, to 8 dm. tall. Leaf-sheaths usually glabrous; leaf-blades to 6 mm. wide, glabrous or pubescent. Racemes 2-5, digitate or subdigitate, the rachis-margins very narrow. Spikelets to 1.5 mm. long, puberulent or glabrous. First glume wanting; second glume about 1 mm. long. Sterile lemma as long as the spikelet. Fertile lemma dark-brown, shining. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5335 (GH); NOR YUNGAS: Coripata, *Hitchcock* 22674 (GH).

4. **D. leiantha** (Hack.) Parodi in Physis, 7: 57 (1923). Perennial, to 1 m. tall, glabrous. Racemes stiff, erect. Spikelets 3 mm. long, glabrous. First glume absent; second glume obtuse, shorter than the spikelet. Sterile lemma as long as the spikelet. Fertile lemma acute, shining, chestnut-brown. SANTA CRUZ: VALLEGRANDE: Coripata, *Herzog* 1763 (US).

5. **D. lanuginosa** (Nees) Henr. in Meded. Rijks Herb. Leiden, no. 61: 5 (1930). Perennial, to 1 m. tall. Leaf-sheaths and blades pubescent. Racemes to 10 cm. long. Spikelets 2.5 mm. long, pubescent on the nerves, acuminate. First glume absent; second glume and sterile lemma as long as the spikelet. Fertile glume shorter than the sterile lemma and glume, pale in color. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 6849 (GH), 6877 (GH).

74. **Thrasya** HBK.

Thrasya campylostachya (Hack.) Chase in Proc. Biol. Soc. Wash. **24:** 115 (1911). Perennial, to about 5 dm. high. Leaf-sheaths densely ciliate, the linear blades to 5 mm. wide, sparsely ciliate and densely puberulent. Inflorescence solitary, terminal or axillary racemes to 9 cm. long, the base often partly sheathed by a stem-leaf, the rachis rather broadly winged and partly concealing the bases of the paired, shortly pedicellate spikelets. Spikelets about 3 mm. long, unilateral, disarticulation below the glumes, 2-flowered, the lower a sterile lemma. First glume usually hyaline, 1 mm. long or less, the second glume about 2.5 mm. long, about 5-nerved, the back rounded, often puberulent along the nerves, the apex shortly penicillate. Lemma about 2.5 mm. long, usually slightly shorter than the second glume, indurate, finely striate, the apex shortly penicillate. Palea shorter than the

lemma, indurate, striate, the 2 keels thick, rounded and shining. LA PAZ: NOR YUNGAS: San José, 1500 m., *Hitchcock* 22733 (GH); Coripata, *Hitchcock* 22694 (GH).

75. **Pseudechinolaena** Stapf

Pseudechinolaena polystachya (HBK.) Stapf in Prain, Fl. Trop. Afr. 9: 495 (1919). Sprawling annual, in moist habitats, rooting at the nodes, the fruiting culms to 5 dm. high. Leaf-sheaths densely pilose, the lance-ovate blades to 6 cm. long, sparsely pilose above and beneath. Inflorescence axillary or terminal, the racemes solitary or arranged in a lax panicle, the rachis, branches and pedicels scabridulous-puberulent, the individual racemes 2-5 cm. long. Spikelets 2-flowered, the lower floret sterile or staminate, the upper perfect, about 4 mm. long, disarticulation below the glumes. First glume about 3 mm. long, 5-nerved, rather sparsely short-hispid; second glume 4 mm. long, several-nerved, short-hispid when young, ventricose and uncinate-spiny at maturity. Sterile lemma firm, minutely papillate, slightly shorter than the second glume, its palea nearly as long, but much narrower. Fertile lemma about 2 mm. long, shining, indurate, the narrow indurate palea about as long. LA PAZ: LARECAJA: Hacienda Simaco, 140[illegible] m., *Buchtien* 5320 (GH); Polo-Polo, 1100 m., *Buchtien* 265 (GH); Milluguaya, 1300 m., *Buchtien* 265 (GH). COCHABAMBA: CHAPARE: Locotal, 1500 m., *Steinbach* 9054 (GH), 9070 bis (GH).

76. **Rhynchelytrum** Nees

Rhynchelytrum repens (Willd.) C. E. Hubb. in Kew Bull. **1934:** 110 (1934). *Tricholaena rosea* of the Catalogue. Annual (or sometimes perennial ?), often decumbent at the base, the culms to 1 m. tall. Leaf-sheaths glabrous to sparsely papillate-hirsute; leaf-blades flat, to 2-7 mm. wide, glabrous. Inflorescence an open terminal panicle, to 15 cm. long, the axis glabrous below to puberulent above, branches puberulent around the nodes, pedicels glabrous. Spikelets 2-flowered, the lower floret a sterile or staminate lemma, about 4-5 mm. long (excluding hairs), disarticulation below the glumes. First glume to 1.5 mm. long, extremely obtuse or truncate, silky-villous; second glume to 4 mm. long, apically obtuse and bidentate, with a 1.5 mm. awn arising from the base of the sinus, long-ciliate, densely silky-villous (at least below), the hairs exceeding the spikelet by 4-5 mm. Sterile lemma as long as second glume, bidentate, shortly awned, silky-villous. Fertile lemma 2.5-3 mm. long, glabrous, rather shining, obtuse, palea similar and nearly as long, but narrower. COCHABAMBA: CERCADO: about 5 km. southeast of Cochabamba, 2800 m., *Eyerdam* 24918 (GH).

The panicle of this ornamental grass varies in color from white and gray to pale or deep rosy-purple.

77. **Mesosetum** Steud.

See Swallen in Brittonia, **2**: 363-392 (1937).

Mesosetum cayennense Steud. Syn. Gram. 118 (1854). Perennial, caespitose, 3-12 dm. high. Leaf-sheaths pilose, ciliate, the flat blades to 5 mm. wide, papillose-pilose above and beneath. Inflorescence a solitary terminal raceme to 20 cm. long, the spikelets solitary, unilateral in 2 rows on the rachis. Spikelets 4-5 mm. long, 2-flowered, the lower floret a sterile lemma, or sometimes staminate, the upper floret perfect, disarticulation below the glumes. Glumes unequal, the first to 3 mm. long, truncate, the apex somewhat erose, the margins appressed-pilose below with a tuft of long hairs on each side at the middle, the back toward the rachis; second glume to 5 mm. long, the margins appressed-pilose on the lower half, a tuft of hairs on each side at the middle, and a tuft of long hairs on each margin well below the erose or bidentate apex. Sterile lemma somewhat shorter than the second glume, a tuft of long hairs on each margin at the middle, a few hairs at the base. Fertile lemma smooth, shining, about 3 mm. long. LA PAZ: CAUPOLICÁN: Ixiamas, *White* (M. E.) 2318 (Swallen).

78. **Eriochloa** HBK.

Erect perennials, 2 dm. to 1 m. tall. Inflorescence a terminal panicle of 2-many somewhat distant racemes. Spikelets short-pedicellate, unilateral in 2 rows, 2-flowered, the lower floret a sterile lemma, the first glume a minute sheath adnate to the first rachilla-joint as a thickened callus; second glume and sterile lemma similar in appearance and size, the glume sometimes awned; fertile lemma indurate, finely papillate-rugulose, mucronate or awned or merely penicillate.

Pedicels pilose, with an apical ring of long hairs; leaf-blades narrow (to 4 mm.); racemes 2 (-3). ..... 1. *E. distachya.*

Pedicels puberulent, lacking an apical ring of long hairs; leaf-blades to 1.5 cm. wide; racemes numerous. ..... 2. *E. punctata.*

1. **Eriochloa distachya** HBK. Nov. Gen. & Sp. **1**: 95 (1816). Plants 2-4 dm. tall, branched, the nodes pubescent, leaves glabrous, blades to 4 mm. wide. Inflorescence of 2, rarely 3, racemes 1-2 cm. long; main axis, raceme-axes and pedicels pilose to pilose-hispid, the pedicels wth an apical ring of long hairs. Spikelets about 4 mm. long (excluding the awn). Second glume and sterile lemma pilose, acute, the glume sometimes awned. Fertile lemma 2.5-3 mm. long, the apex penicillate. SANTA CRUZ: SARA: Río Dolores, *Steinbach* 1940 (GH).

2. **E. punctata** (L.) Desv. ex Hamilton, Prodr. Pl. Ind. Occ. 5 (1825). Plants to 1 m. or more in height, basally decumbent, branched, nodes puberulent, leaves glabrous, the blades flat, to 1.5 cm. wide. Inflorescence of numerous racemes mostly over 2 cm. long; main axis and raceme-axes pilose, pedicels puberulent and without an apical ring of long hairs. Spikelets about 4 mm. long. Second glume and sterile lemma sparseiy pilose, acute. Fertile lemma over 2 mm. long, the apex not penicillate but awned, the awn about 1 mm. long. LA PAZ: NOR YUNGAS: Coripata, Hacienda El Choro, 1700 m., *Buchtien* 8040 (GH); SUR YUNGAS: Chulumani, 1600 m., *Hitchcock* 22666 (GH).

79. **Brachiaria** (Trin.) Griseb.

Brachiaria plantaginea (Link) Hitchc. in Contrib. U. S. Nat. Herb. **12:** 212 (1909). Annual, decumbent, rooting at the nodes, culms to 5 dm. high. Leaves glabrous, the lance-ovate blades to 1.5 cm. wide. Inflorescence a series of terminal, unilateral racemes to 7 cm. long, the solitary spikelets in 2 rows along the rachis. Spikelets 2-flowered, the lower floret sterile or staminate, the upper floret perfect, to 5 mm. long, disarticulation below the glumes. Glumes subequal to unequal; first glume about 2 mm. long, but often longer, completely surrounding the base of the second glume, rather thin-textured, about 7-nerved, its back toward the rachis, second glume to 5 mm. long, firmer-textured, about 7-nerved, the apex sometimes mucronulate. Sterile lemma as long as the second glume and similar in appearance. Fertile lemma about 3 mm. long, somewhat indurate, densely papillate-striate. Palea similar to fertile lemma, enfolded by the margins of the latter. LA PAZ: NOR YUNGAS: Polo-Polo, 1100 m., *Buchtien* 443 (GH); Milluguaya, 1300 m., *Buchtien* 158 (GH); Coripata, 1700 m., *Buchtien* 8041 (GH).

80. **Axonopus** Beauv.

See Black in Advancing Frontiers of Plant Science, vol. 5 (1963).

Perennial (1 Bolivian species annual), mostly tall. Leaf-blades involute or flat or folded. Inflorescence a panicle or subpaniculate, of few to many racemes conjugate, digitate, or distant along a common axis. Spikelets solitary, unilateral in 2 rows along the rachis, disarticulation below the glumes, 2-flowered, the lower floret a sterile lemma, the perfect floret above it. First glume absent; second glume and sterile lemma more or less alike in size and appearance; second glume and fertile lemma turned away from the rachis. Fertile lemma indurate, whitish or yellowish to dark brown, the margins curved over the edge of the similar palea but not enclosing it.

a. Rachis hispid or pilose.
b. Rachis-hairs not hispid nor papillate-based. ..... 10. *A. pilosus.*
b. Rachis-hairs hispid, papillate-based.

c. Hairs not yellow nor golden-brown. ..... 14. *A. elegantulus.*
c. Hairs yellow to golden-brown.
d. Spikelets in cupular cavities along the rachis. ..... 17. *A. chrysoblepharis.*
d. Spikelets not in cupular cavities.
e. Rachis not obviously flexuose; glume with papillate-hispid hairs on the nerves. ..... 16. *A. Herzogii.*
e. Rachis obviously flexuose; glume without papillate-hispid hairs.
f. Glume and sterile lemma glabrous, occasionally very slightly puberulent. ..... 19. *A. chrysites.*
f. Glume and sterile lemma shortly and finely pubescent. ..... 18. *A. exasperatus.*

a. Rachis neither hispid nor ciliate.
g. Spikelets obviously hirsute. ..... 2. *A. marginatus.*
g. Spikelets not hirsute but glabrous to sparsely puberulent.
h. Leaves papillate-pilose, at least when young.
i. Leaf-blades to 4 mm. wide. ..... 4. *A. hirsutus.*
i. Leaf-blades to 3 cm. wide. ..... 12. *A. scoparius.*
h. Leaves essentially glabrous, at least on upper surface.
j. Culm-nodes not glabrous.
k. Racemes 2-4 in panicle; if 4, the upper 2 conjugate. ..... 6a. *A. compressus* var. *macropodius.*
k. Racemes much more numerous in panicle.
l. Racemes up to 20; distant and divergent on the common axis. ..... 13. *A. iridifolius.*
l. Racemes more than 20; approximate and ascending on the common axis.
m. Spikelets about 2 mm. long; leaf-blades subpetiolate at base. ..... 7. *A. eminens* var. *bolivianus.*
m. Spikelets about 2.5 (-3) mm. long; blades not subpetiolate. ..... 8. *A. barbigerus.*
j. Culm-nodes glabrous.
n. Leaf-blades abruptly rounded at base.
o. Spikelets to 1.6 mm. long. ..... 15. *A. capillaris.*
o. Spikelets to 2.4 mm. long. ..... 6. *A. compressus.*
n. Leaf-blades not abruptly rounded at base.
p. Blades tightly involute, appearing terete. ..... 9. *A. siccus.*
p. Blades flat or folded.
q. Blades acuminate, acute. ..... 11. *A. andinus.*
q. Blades not acuminate, obtuse.
r. Culms mostly 2 dm. tall. ..... 5. *A. fissifolius.*
r. Culms about 6 dm. tall.
s. Glumes pilose on the nerves, especially at base and apex. ..... 1. *A. Purpusii.*

s. Glumes sparsely puberulent to glabrous. .... 3. *A. affinis.*

1. **Axonopus Purpusii** (Mez) Chase in Journ. Wash. Acad. Sci. **17:** 144 (1927). Perennial, to 7 dm. tall, culm-nodes usually glabrous. Leaf-sheaths ciliate, at least near summit; blades flat or folded, to 4 mm. wide, shorter than inflorescence, glabrous or sparsely papillate-pubescent, ciliate at the base. Inflorescence of 2-7 erect racemes, to 7 cm. long, the rachis scabridulous, flexuose, the pedicels sometimes densely hairy. Spikelets to 2.2 mm. long, ovoid to oblong, greenish or brownish-purple. Glume and sterile lemma equal, mostly 2-nerved, the mid-nerve absent, pilose on the nerves, at least at base and apex. Fertile lemma a little shorter than or equaling the spikelet, yellowish, glabrous or minutely penicillate at apex. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 7060 bis, in part (GH).

The description given is based in part on an isotype in the Gray Herbarium, *Purpus* 2450.

2. **A. marginatus** (Trin.) Chase in Contrib. U. S. Nat. Herb. **17:** 226 (1913). Perennial, to 8.5 dm. high, sometimes stoloniferous or rhizomatous. Culm-nodes pubescent or barbate, sometimes glabrous. Leaf-sheaths glabrous, or pilose near the apex; blades 2-4 mm. wide, to 30 cm. long, flat or folded, ciliate at base, glabrous above, pilose or sparsely pilose beneath, the obtusely acuminate apex naviculate. Inflorescence of up to 13 ascending racemes to 15 cm. long, the rachis scabrid, pedicels pubescent, especially on the margins. Spikelets 2-3 mm. long, ellipsoid to oblong. Glume and sterile lemma equal, 2-4-nerved, mid-nerve absent, densely hairy along (but seldom on) the nerves, the hairs dark purple to silvery, becoming light to dark brown. Fertile lemma about equal to sterile lemma, white or nearly so, the apex penicillate. LA PAZ: LARECAJA: Hacienda Casana, 1600 m., *Buchtien* 7118 (US).

3. **A. affinis** Chase in Journ. Wash. Acad. Sci. **28:** 180 (1938). Caespitose perennial, to 6.5 dm. tall. Culms erect or geniculate, the nodes glabrous. Leaf-sheaths ciliate toward apex, otherwise glabrous; blades folded or flat, the base sometimes sparsely pilose, otherwise glabrous. Inflorescences terminal the panicle of 2-7 racemes to about 8 cm. long, rachis glabrous or slightly scabridulous, straight to flexuose. Spikelet to 2.1 mm. long, elliptic to ovate. Glume and sterile lemma equal, 2-4-nerved, midrib absent, lateral nerves sparsely pubescent to glabrous. Fertile lemma equal to or somewhat shorter than the sterile lemma, pale yellow, glabrous or the apex somewhat penicillate. SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 5183 (GH), 6724 (GH), 6847 (GH).

4. **A. hirsutus** G. A. Black in Advanc. Front. Pl. Sci. **5:** 55 (1963). Perennial, the culms to 2.5 dm. tall, nodes densely pilose. Leaf-sheaths carinate, densely ciliate, densely pilose at the apex; blades to 20 cm. long, 4 mm. wide, flat, linear, attenuate at the apex, densely papillate-

pilose, ultimately glabrescent. Inflorescence terminal, solitary, of 4-5 subdigitate racemes to 8 cm. long, rachis scabrous, flexuose. Spikelet to 1.6 mm. long, ovate to oblong-elliptic. Glume and sterile lemma equal, 2-4-nerved, sparsely pubescent along the inner nerves. Fertile lemma slightly shorter, stramineous to brown, shining, glabrous. SANTA CRUZ: SARA: Matacú [Motacú] — Portachuelo, *Steinbach* 1979 (GH; probable isotype).

5. **A. fissifolius** (Raddi) Kuhlm. in Comm. Linh. Telegr. Estrat. Matto Grosso Amazonas, Publ. 67, Annexo 5, Bot. **11**: 87 (1922). Perennial, to 4.5 dm. tall (usually about 2 dm.), nodes glabrous. Leaf-sheaths ciliate at the apex; blades to 4 mm. wide, usually glabrous, ciliate at the base, obtuse. Inflorescences mostly terminal panicles of 1-3 racemes to 7 cm. long (occasionally to 10 cm.); rachis glabrous, straight to flexuose. Spikelet to 2.1 mm. long, ovate to elliptic. Glumes and sterile lemma equal, 2-4-nerved, sparsely pubescent on the nerves, stramineous. Fertile lemma as long as the sterile, light yellow to whitish, glabrous or minutely penicillate. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5326 (GH); NOR YUNGAS: Polo-Polo, 1100 m., *Buchtien* 267 (GH); Coroico, 1560 m., *Hitchcock* 22716 (GH); SUR YUNGAS: La Florida, 1840 m., *Hitchcock* 22625 (GH). SANTA CRUZ: SARA: Buenavista, Dolores, *Steinbach* 1908 (GH).

6. **A. compressus** (Swartz) Beauv. Ess. Agrost. 154 (1812). Perennial, stoloniferous. Culms to 8 dm. high, but usually to 4.5 dm., nodes glabrous to pubescent. Leaf-sheaths ciliate, pubescent near the apex or glabrous; blades flat, to 2 cm. wide, lance-linear to ovate, usually ciliate, sometimes the upper surface pubescent to pilose. Inflorescences terminal or terminal and lateral, the panicle of 2-5 racemes to 13 cm. long, the uppermost conjugate; rachis scabrid to pilose, flexuose or nearly straight. Spikelet to 3 mm. long on pedicels up to 1 mm. long. Glume and sterile lemma equal, 2-5-nerved, sparsely pubescent along the outermost nerves, or glabrous, stramineous to purple. Fertile lemma to 1.8 mm. long, glabrous or shortly penicillate. SANTA CRUZ: SARA: Buenavista, 500 m., *Steinbach* 5159 (GH); Dolores, *Steinbach* 1907 (GH).

6a. **A. compressus** var. **macropodius** (Steud.) G. A. Black in Advanc. Front. Pl. Sci. **5**: 82 (1963). Perennial, to 6 dm. high, culm-nodes pilose. Leaf-sheaths glabrous except along the margins and at the apex; blades to 2 dm. long and 12 mm. wide, elliptic, ciliate near the base; petiolately narrowed at the base, apex obtuse. Panicle of 2-4 racemes, these often conjugate, rachis and pedicels glabrous. Spikelet to 2.5 mm. long. Second glume and sterile lemma 2-4-nerved, very sparsely short-pilose along the nerves, especially at the base. Fertile lemma about 0.75 mm. shorter than the sterile lemma, whitish, more or less striate or papillate-striate. COCHABAMBA: CHAPARE: Antahuacana, Espíritu Santo, 750 m., *Buchtien* 2505 (US).

7. **A. eminens** var. **bolivianus** G. A. Black in Advanc. Front. Pl. Sci. 5: 93 (1963). Perennial, robust, to 2.5 m. tall (*fide* Steinbach), the culm-nodes densely barbate. Leaf-sheaths densely ciliate and pilose near the apex; blades involute, subpetiolate at the base, becoming flat, to 1 cm. wide, upper surface pilose near the base, the apex long-acuminate to pungent. Panicle terminal, to 35 cm. long, of numerous approximate racemes (usually at least 50) to 18 cm. long; rachis scabrous. Spikelet to 2 mm. long, ovoid; glume and sterile lemma equal, 5-nerved, glabrous or sparsely pubescent. Fertile lemma shorter than the sterile, white, glabrous to penicillate. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 6976 (GH).

8. **A. barbigerus** (Kunth) Hitchc. in Contrib. U. S. Nat. Herb. **24:** 433 (1927). Stout perennial, the culms to 1-2 m. tall, nodes usually densely pilose but occasionally glabrous. Leaf-sheaths ciliate at the apex, the base sometimes pubescent; blades to 9 dm. long and 6 mm. wide, long-attenuate at the apex, involute or folded at the base. Inflorescences terminal, usually solitary, of 10-50 or more ascending racemes to 20-30 cm. long, rachis scabrous with occasional long hairs. Spikelet about 2.5 mm. long (but occasionally to 3.1 mm.). Glume and sterile lemma equal, 5-nerved, glabrous or sparsely pubescent between the nerves. Fertile lemma about equaling the sterile, or shorter, pale yellow to white, glabrous or penicillate. LA PAZ: [province unknown]: Puente Villa, *Cárdenas* 3608 (GH). SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 1920 (GH), 5377 (GH).

9. **A. siccus** (Nees) Kuhlm. in Comm. Linh. Telegr. Estrat. Matto Grosso Amazonas, Publ. 67, Annexo 5, Bot. **11:** 87 (1922). Slender perennial, the culms mostly to 9 dm. tall but occasionally much taller, the nodes usually glabrous. Leaf-sheaths ciliate, at least near the apex; blades tightly involute, appearing terete, the apex slender and filamentous. Panicles terminal, of 4-30 racemes to 15 cm. long, rachis scabrid. Spikelets to 2.1 mm. long. Glumes and sterile lemma equal, 5-nerved, glabrous, or puberulent between the nerves. Fertile lemma equalling the sterile, white to stramineous, glabrous or penicillate. SANTA CRUZ: VALLEGRANDE: Samaipata, *Herzog* 1709 (US). TARIJA: O'CONNOR: Narvaez, 2700 m., *Cárdenas* 4935 (US).

10. **A. pilosus** G. A. Black in Advanc. Front. Pl. Sci. **5:** 100 (1963). Perennial, the culms to 5 dm. tall with pubescent nodes. Leaf-sheaths somewhat pilose, especially near the apex, the hairs tufted at the base of the blade; blades to 2.5 mm. wide, folded, ciliate at the base, the upper surface pilose, the apex very long-acuminate or filamentous. Inflorescence a solitary terminal panicle of many (to 25) racemes to 10 cm. long; rachis flexuose, densely pilose, the hairs not hispid nor yellow-brown, mostly aggregated around the short pedicels. Spikelets to 2.7 mm. long, long-ellipsoid, often purplish. Glume and sterile lemma equal, 5-nerved, glabrous to sparsely pubescent. Fertile lemma

greenish to white, penicillate. TARIJA: MENDEZ: Tucumilla, 2600 m., *Fiebrig* 2782 (GH; type-number).

11. **A. andinus** G. A. Black in Advanc. Front. Pl. Sci. **5**: 111 (1963). Perennial, to 1 m. tall, culm-nodes glabrous. Leaf-sheaths somewhat short-pilose at the apex, otherwise glabrous; blades long, to 5 mm. wide, loosely folded or flat, glabrous or with a few hairs on the upper surface at the base. Panicles of 5-7 racemes to 10 cm. long; rachis and pedicels scabrid on the angles. Spikelets about 2.5 mm. long, lanceolate. Second glume and sterile lemma equal, often purplish (at least on the type), 2-4-nerved, the nerves short-pilose. Fertile lemma shorter than the sterile, yellowish-white, obscurely striatulate, the acute apex penicillate. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5328 (US; type).

12. **A. scoparius** (Flügge) Kuhlm. in Comm. Linh. Telegr. Estrat. Matto Grosso Amazonas, Publ. 67, Annexo 5, Bot. **11**: 45 (1922). *Paspalum tripinnatum* Mez in Fedde, Rep. Sp. Nov. **15**: 64 (1917). Stout perennial, the culms to 1.5 m. tall, nodes glabrous. Leaf-sheaths glabrous; blades to 5 dm. long and 3 cm. wide, the apex obtuse, the upper surface papillate-pilose. Inflorescences terminal (sometimes axillary as well), of few to 100 racemes to 20 cm. long; rachis scabrid and sometimes sparsely short-pilose. Spikelets to 2.4 mm. long. Glume and sterile lemma equal, usually 5-nerved, short-pubescent between the nerves. Fertile lemma mostly shorter than the sterile, pale yellow, glabrous or penicillate. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5324 (GH). COCHABAMBA: CHAPARE: Locotal, 1500 m., *Steinbach* 9093 in part (GH).

The Steinbach specimen is only an inflorescence-fragment and the present attribution may be an error.

13. **A. iridifolius** (Poepp.) G. A. Black in Advanc. Front. Pl. Sci. **5**: 125 (1963). Perennial, to 1 m. tall, the culm-nodes densely pubescent. Leaf-sheaths scabrid, carinate, pubescent to long-pilose at the apex; blades flat, to 1.9 cm. wide, obtuse, upper surface scabrid or strigose at base. Inflorescence a terminal panicle of 6-20 distant racemes to 18 cm. long; rachis somewhat flexuose, scabrid. Spikelets to 3 mm. long, greenish to purple. Glume and sterile lemma equal, 4-5-nerved, often puberulent between the nerves. Fertile lemma shorter than the sterile, stramineous, the apex penicillate. LA PAZ: NOR YUNGAS: Polo-Polo, 1100 m., *Buchtien* 448 (GH).

14. **A. elegantulus** (Presl) Hitchc. in Contrib. U. S. Nat. Herb. **24**: 433 (1927). Perennial, the culms to 7.5 dm. tall, the nodes glabrous. Leaf-sheaths papillate-pilose to glabrous, papillate-ciliate; blades folded at base, flat above, to 25 cm. long and 5 mm. wide, long-attenuate, papillate-pilose to glabrous. Inflorescence terminal, of up to 12 subdigitate racemes to 10 cm. long; rachis ciliate, with few to no hairs immediately below the spikelets, hairs papillate-based but neither hispid nor golden-brown. Spikelets to 2.5 mm. long, greenish

to purple. Glume and sterile lemma equal, 2-3-nerved, glabrous. Fertile lemma sometimes slightly longer than the sterile, glabrous, shiny brown. LA PAZ: LARECAJA: San Carlos, Mapiri, *Buchtien s. n.* (Black). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 7060 (at least as to GH sheet).

15. **A. capillaris** (Lam.) Chase in Proc. Biol. Soc. Wash. **24:** 133 (1911). Lax annual, to 7.5 dm. high, nodes glabrous, the lowest sometimes rooting, culms geniculate. Leaf-sheaths ciliate; blades flat, to 8 mm. wide, lanceolate, acuminate, the edges undulate, abruptly rounded and more or less clasping at the base, pilose at the base, the main portion of the blade glabrous or pubescent. Inflorescence terminal, of 2-6 paired or subdigitate racemes to 8 cm. long; rachis and peduncles capillary, the rachis markedly flexuose and scabridulous. Spikelets to 1.6 mm. long, sessile, ellipsoid, obtuse to acute. Sterile lemma and glume equal, with 2-4 inconspicuous nerves, glabrous to sparsely pubescent. Fertile lemma shining, brown, glabrous. LA PAZ: LARECAJA: Mapiri, 1600 m., *Rusby* 241 (GH); Hacienda Simaco, 1400 m., *Buchtien* 5327 (GH); SUR YUNGAS: Chulumani, 1600 m., *Hitchcock* 22657 (GH). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 6879 (GH).

16. **A. Herzogii** (Hack.) Hitchc. in Contrib. U. S. Nat. Herb. 24: 431 (1927). Perennial, to 8 dm. tall, the culm-nodes glabrous. Leaf-sheaths glabrous; blades folded, to 15 cm. long and 3 mm. wide, papillate-ciliate near the base. Panicle of 2-7 subdigitate racemes to 10 cm. long, axis pilose, rachis papillate-ciliate, the hairs yellowish- to golden-brown, long. Spikelet to 2.5 mm. long, lanceolate or lance-ovate, purplish, the pedicels minute. Second glume and sterile lemma equal, 5-nerved, the glume papillate-hispid on the nerves, the sterile lemma with shorter and finer white hairs between the nerves. Fertile lemma nearly as long as the sterile, rather dark brown, obscurely, if at all, striatulate, the acute apex penicillate. SANTA CRUZ: CHIQUITOS: Cerro San Miserate, Santiago, *Herzog* 866 (US; type-number).

17. **A. chrysoblepharis** (Lag.) Chase in Proc. Biol. Soc. Wash. **24:** 134 (1911). Annual or perennial, to 10 dm. tall, the culm-nodes glabrous or pubescent. Leaf-sheaths glabrous to densely pubescent, often hispid-ciliate, especially near the apex; blades to 1.5 cm. wide, usually narrower, pilose to glabrous, acuminate. Inflorescence terminal or lateral, of 2-10 racemes to 4 cm. long, subdigitate; rachis not flexuose, the margins and center densely papillate-hispid, the golden or golden-brown hairs dense, to 3-4 mm. long, basally fused, apex often without spikelets. Spikelets to 1.5 mm. long, fitting into cavities in the rachis, ovoid, obtuse. Glume and sterile lemma equal, glabrous, 2-nerved, very thin. Fertile lemma purple or brown, glabrous, obtuse to subacute. BENI: YACUMA: Reyes, *Rusby* 216 (Black). LA PAZ: NOR YUNGAS: Hacienda Anacuri, *Holway* 708 (Black).

18. **A. exasperatus** (Nees) G. A. Black in Advanc. Front. Pl. Sci.

5: 168 (1963). Straggling perennial to 8 dm. tall, culms often branched at the base, nodes glabrous. Leaf-sheaths glabrous; blades mostly less than 1 dm. long, to 5 mm. wide, with a few stiff hairs near the base, the apex long-acuminate. Inflorescences terminal, 1-2, of 2-7 racemes to 9 cm. long; rachis somewhat flexuose, papillate-hispid, the hairs golden-brown, with a dense tuft of hairs subtending each spikelet, mostly more than 10 hairs in a tuft. Spikelets to 1.5 mm. long, green to purple, ovoid to obovoid, obtuse to subacute. Glume and sterile lemma equal, the 2-4 nerves obscure, short-pubescent, usually sparsely so, or the hairs in 2 rows. Fertile lemma shining brown, glabrous. SANTA CRUZ: SARA: lomas arenosas, 450 m., [Buenavista ?], *Steinbach* 1815 (GH).

19. **A. chrysites** (Steud.) Kuhlm. in Comm. Linh. Telegr. Estrat. Matto Grosse Amazonas, Publ. 67, Annexo 5, Bot. 11: 88 (1922). *A. aureus* of the Catalogue, at least in part. Perennial, straggling to erect, to 7.5 dm. tall, culm-nodes glabrous. Leaves glabrous except for a few hispid hairs at base of upper surface of blade, the blades to 7 mm. wide, attenuate. Inflorescence terminal, 1-2 panicles, the racemes to 8 cm. long; rachis somewhat flexuose, long-hispid on the margins and mid-ridge, with a cluster of hairs to 2.5 mm. long below each spikelet, the hairs yellow- or golden-brown. Spikelets to 1.5 mm. long, obovoid, obtuse, purple to fulvous. Glume and sterile lemma equal, the 2-4 nerves obscure (or absent), glabrous or slightly pubescent. Fertile lemma shining brown, glabrous. SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 5426 (GH), 6948 (GH).

81. Paspalum L.

See Chase in Contrib. U. S. Nat. Herb. 28: 1-310 (1929).

Annual or perennial. Leaf-blades flat or folded at the base. Panicle of 1 to many racemes on a common axis. Rachis of racemes narrow to very broadly winged, sometimes prolonged beyond the ultimate spikelets. Spikelets glabrous or variably pubescent, sessile, sub-sessile or pedicellate, solitary or paired, unilateral on the rachis, often biconvex or planoconvex, disarticulation below the glumes, 2-flowered, the lower floret a sterile lemma, the upper perfect. First glume usually absent, present in some species and occasionally present in others. Second glume usually present, absent in a few species, similar to the sterile lemma in size and appearance. Fertile lemma usually somewhat indurate, often shining, usually somewhat striate or striate-papillate.

a. Rachis prolonged beyond uppermost spikelet.
b. Spikelets glabrous.
c. Glumes absent.
d. Spikelets over 2 mm. long. ..... 4. *P. candidum.*
d. Spikelets less than 2 mm. long.

e. Culms dark; leaf-sheaths glabrous or sparsely pilose along margins. ..... 5. *P. depauperatum.*
e. Culms light; leaf-sheaths densely long-pilose. ..... 6. *P. lineispatha.*
c. Second glume present.
f. Spikelets less than 2 mm. long; rachis less than 2 mm. wide.
g. Plants over 10 cm. high; leaves sparsely pilose to glabrous. ..... 1. *P. penicillatum.*
g. Plants less than 10 cm. high; leaves densely pilose. ..... 2. *P. pygmaeum.*
f. Spikelets over 2 mm. long; rachis at least 2 mm. wide. ..... 3. *P. prostratum.*
b. Spikelets not glabrous.
h. Rachis very broadly winged.
i. Leaf-blades flat, 3-8 mm. wide; racemes usually more than 1. ..... 7. *P. Ceresia.*
i. Leaf-blades very narrow, involute, pilose; racemes rarely more than 1. ..... 8. *P. stellatum.*
h. Rachis very narrowly winged. ..... 39. *P. saccharoides.*
a. Rachis not prolonged beyond uppermost spikelet.
j. Spikelets glabrous.
k. Glumes absent.
l. Rachis puberulent; spikelets mostly over 2 mm. long. ..... 38. *P. boliviense.*
l. Rachis glabrous, with a few long cilia; spikelets mostly less than 2 mm. long. ..... 37. *P. malacophyllum.*
k. Second glume present.
m. Rachis coarsely long-ciliate.
n. Rachis sparsely ciliate, mainly puberulent-scabrid; spikelets mostly over 2 mm. long. ..... 32. *P. millegrana.*
n. Rachis densely ciliate; spikelets mostly less than 2 mm. long. ..... 33. *P. densum.*
m. Rachis not coarsely long-ciliate.
o. Racemes not conjugate.
p. First glume present on 1 or both of the paired spikelets.
q. Spikelets about 1.5 mm. long. ..... 14. *P. decumbens.*
q. Spikelets about 2.5 mm. long. ..... 35. *P. pilosum.*
p. First glume absent or rarely present on 1 spikelet of the pair. ..... 21. *P. inaequivalve.*
o. Racemes conjugate.
r. Spikelets about 1 mm. long. ..... 20. *P. pictum.*
r. Spikelets 2-3 mm. long.
s. Spikelets 2.5-3 mm. long. ..... 25. *P. notatum.*
s. Spikelets 2-2.5 mm. long. ..... 26. *P. minus.*
j. Spikelets not glabrous.
t. Rachis coarsely scabrid-ciliate. ..... 30. *P. virgatum.*

t. Rachis not coarsely scabrid-ciliate.
u. Spikelet-hairs swollen-globose. ..... 19. *P. multicaule.*
u. Spikelet-hairs not swollen-globose.
v. Spikelets with long silky hairs.
w. Racemes neither solitary nor conjugate.
x. Spikelets to 2.5 mm. long. ..... 24. *P. Urvillei.*
x. Spikelets 3.5 mm. long, or more.
y. Sterile lemma glabrous.
z. Racemes 2-5; leaf-blades stiffly pilose (at least on margins). ..... 9. *P. Humboldtianum.*
z. Racemes 8-16; leaf-blades glabrous or nearly so. ..... 11. *P. Buchtienii.*
y. Sterile lemma not glabrous.
aa. Leaf-blades ciliate at base, otherwise glabrous. ..... 23. *P. dilatatum.*
aa. Leaf-blades puberulent or pilose.
bb. Blades puberulent on both surfaces. ..... 12. *P. polyphyllum.*
bb. Blades sparsely to densely pilose. ..... 10. *P. erianthum.*
w. Racemes solitary or conjugate.
cc. Racemes solitary. ..... 36. *P. Ekmanianum.*
cc. Racemes conjugate. ..... 22. *P. conjugatum.*
v. Spikelets lacking long silky hairs.
dd. Racemes conjugate (rarely a third raceme present below). ..... 13. *P. distichum.*
dd. Racemes not conjugate.
ee. First glume present on 1 of the paired spikelets.
ff. Plants to 8.5 dm. tall; second glume sometimes puberulent on the margin only. ..... 15. *P. inconstans.*
ff. Plants to 4.5 dm. tall; second glume obscurely puberulent or pubescent at the summit. ..... 16. *P. lepidum.*
ee. First glume lacking.
gg. Spikelets 2 mm. or less in length.
hh. Fruit dark brown. ..... 27 *P. melanospermum.*
hh. Fruit pale.
ii. Sterile lemma pubescent. .. 17. *P. paniculatum.*
ii. Sterile lemma glabrous. ..... 18. *P. Juergensii.*
gg. Spikelets over 2 mm. long.
jj. Fruit pale.
kk. Leaf-blades densely pubescent on both surfaces. ..... 16. *P. lepidum.*
kk Leaf-blades glabrous, scabrous on margins. ..... 34. *P. remotum.*

jj. Fruit dark.
ll. Sterile lemma transversely rugulose near base. ..... 28. *P. plicatulum*.
ll. Sterile lemma not rugulose.
mm. Spikelets to 2.5 mm. long. ..... 29. *P. collinum*.
mm. Spikelets 2.7-3 mm. long. ..... 31. *P. conspersum*.

1. **Paspalum penicillatum** Hook. f. in Trans. Linn. Soc. **20:** 171 (1851). Annual, decumbent, to 4 dm. tall. Leaf-blades to 13 cm. long and 1.5 cm. wide, glabrous beneath, sparsely pilose above, ultimately glabrate and somewhat pilose-ciliate near the base. Panicle of several racemes, usually paired, to 3 cm. long, usually nearer 2 cm., the rachis of each raceme extended well beyond the uppermost spikelet, less than 2 mm. wide. Spikelets to 1.7 mm. long, glabrous, second glume present. Sterile lemma as long as spikelet, thin, several-veined. Fertile lemma dull white. LA PAZ: LARECAJA: Sorata, 2650-2800 m., *Mandon* 1250 (GH); Sorata, *Bang* 1310 (GH); Sorata, 2800 m., *Rusby* 240 (GH); NOR YUNGAS: Coripata, 1700 m., *Buchtien* 8050 (GH); SUR YUNGAS: La Florida, 1840 m., *Hitchcock* 22643 (GH).

2. **P. pygmaeum** Hack. in Fedde, Rep. Sp. Nov. **11:** 18 (1912). *P. pygmaeum* var. *glabrescens* Hack. in Fedde, Rep. Sp. Nov. **11:** 18 (1912). Matted, branched annual, culms to 1 dm. long, usually shorter. Leaf-sheaths rather densely pilose; blades short, usually to 3 cm. long, more sparsely pilose above and beneath. Panicles small, with 2-6 racemes 0.5-2 cm. long, the rachis less than 2 mm. wide, extended beyond the uppermost spikelet. Spikelets less than 2 mm. long, glabrous. Second glume present, 3-nerved, sterile lemma similar, the 3 nerves in a central position. Fertile lemma smooth, not highly shining. LA PAZ: MURILLO: La Paz, 3900 m., *Buchtien* 2490 (GH; type-number of *P. pygmaeum* var. *glabrescens*); Talca Chuquiaguillo, *Bang* 808 (GH). COCHABAMBA: CHAPARE: La Aduana, 3100 m., *Steinbach* 9579 (GH).

3. **P. prostratum** Scribn. & Merr. in U. S. Dept. Agric. Div. Agrost. Bull. no. 24: 9 (1900). Annual, decumbent or prostrate, the culms to 3 dm. long, often rooting at the nodes. Leaf-sheaths sparsely pilose-ciliate or glabrous to densely pilose; blades to 8 cm. long and 1.2 cm. wide, papillate-pilose above and beneath. Panicle of 3-12 solitary to somewhat fasciculate racemes 1-3 cm. long, the rachis about 2.5 mm. wide, extended beyond the uppermost spikelet. Spikelet to 2.2 mm. long, glabrous, second glume present, sterile lemma similar, 3-nerved. Fertile lemma nearly as long as the spikelet, smooth, shining. LA PAZ: LARECAJA: Sorata, *Holway* 507 (US). COCHABAMBA: CERCADO: Morochata, 2900 m., *Cárdenas* 3414 (US).

4. **P. candidum** (Humb. & Bonpl. ex Flügge) Kunth in Mém. Mus. Hist. Nat. **2:** 68 (1815). Annual, decumbent, straggling, the culms

often to 1 m. or more in length, the dark nodes somewhat enlarged and strigose to villous. Leaf-sheaths ciliate near the apex, otherwise pilose or glabrous; blades to 12 cm. long and 1.2 cm. wide, finely pilose on both surfaces. Panicle lax, with 7-20 ascending solitary racemes to 4 cm. long, rachis to 2.5 mm. wide, prolonged beyond the uppermost spikelet. Spikelets to 2.5 mm. long, glabrous, both glumes absent. Sterile lemma 3-nerved. Fertile lemma shorter than the sterile, smooth, ivory-white, shining. LA PAZ: SUR YUNGAS: San Felipe, 2800 m., *Hitchcock* 22597 (GH); Sirupaya, 2100 m., *Buchtien* (in *Baenitz Herb. Amer.*) 1408 (GH).

5. **P. depauperatum** Presl, Rel. Haenk. 1: 215 (1830). *P. vinosum* Mez in Fedde, Rep. Sp. Nov. 15: 28 (1917). Decumbent annual, the dark, purplish culms to 1.8 dm. long. Leaf-sheaths glabrous, or, in youth, pilose near the apex, ciliate; blades to 7 cm. long and 4 mm. wide, pilose or papiliate-pubescent on both surfaces. Panicle of up to 7 solitary racemes, 15-3 cm. long, the rachis prolonged beyond the uppermost spikelet. Spikelets glabrous, less than 2 mm. long, glumes absent. Sterile lemma 3-veined. Fertile lemma shining. COCHABAMBA: CHAPARE: Incachaca, 2250 m., *Steinbach* 9495 (GH).

6. **P. lineispatha** Mez in Fedde, Rep. Sp. Nov. 15: 27 (1917). Rather straggling annual, the light-colored culms to 30 cm. tall. Leaf-sheaths densely papillate-pilose; blades to 6 cm. long and 9 mm. wide, densely papillate-pilose beneath, sparsely so above. Panicle of 2-12 solitary racemes to 1.5 cm. long, the rachis prolonged beyond the uppermost spikelet, less than 2 mm. wide. Spikelets glabrous, less than 2 mm. long, glumes absent. Sterile lemma 3-veined. Fertile lemma shining. LA PAZ: LARECAJA: Hacienda Casana near Tipuani, 1400 m., *Buchtien* 7112 (GH).

7. **P. Ceresia** (O. Ktze.) Chase in Niles in Contrib. U. S. Nat. Herb. 24: 153 (1925). *P. membranaceum* of the Catalogue. Perennial, to 6 dm. tall, villous at the base, shortly rhizomatous. Leaf-blades to 15 cm. long and 8 mm. wide, pilose near the margin on the upper surface. Panicle of 1-4 distant racemes, the rachis-proper dark, with orange-brown broad margins, to 1 cm. wide overall, prolonged beyond the uppermost spikelet. Spikelets to 4 mm. long, with a dense silver-white pilosity, the longest hairs as long as the spikelet, hairs mostly papillate-based. Second glume present. Without locality: *Bang* 1080 (GH). LA PAZ: LARECAJA: Cerro del Iminapi, 2600-2700 m., *Mandon* 1255 (GH). SANTA CRUZ: SARA: Buenavista, 500 m., *Steinbach* 5421 (GH).

8. **P. stellatum** Humb. & Bonpl. ex Flügge, Monogr. Pasp. 62 (1810). Caespitose perennial to 5 dm. tall. Leaf-sheaths densely long-pilose. Inflorescence of 1 arcuate raceme (rarely 2) to 10 cm. long, the broad yellow-brown rachis prolonged beyond the uppermost spikelet. Spikelets to 2.5 mm. long, second glume present; second glume and sterile lemma with very short white hairs and long shining hairs,

these more or less stellate in arrangement. Fertile lemma shorter than the spikelet. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 1988 (GH), 7103 (GH).

9. **P. Humboldtianum** Flügge, Monogr. Pasp. 67 (1810). Caespitose perennial to 8 dm. tall, the base rather woody. Leaf-sheaths papillate-pilose, sometimes glabrate; blades flat, to 18 cm. long and 1.5 cm. wide, papillate-pilose or glabrate. Panicle of 2 to several racemes, neither solitary nor conjugate, the narrow rachis not coarsely scabrid-ciliate, not exceeding the uppermost spikelet, usually dull purple. Spikelets mostly purple, to 3.5-4 mm. long. Second glume present, shortly pubescent with appressed hairs, the margins with numerous long papillate-based hairs. Sterile lemma shorter than second glume, glabrous. Fertile lemma dull white, thin-textured. LA PAZ: LARECAJA: Cerro del Iminapi, 2650 m., *Mandon* 1254 (GH). COCHABAMBA: MIZQUE: near Vilavila, 2500 m., *Eyerdam* 24977 (GH); CHAPARE: Locotal, 1900 m., *Steinbach* 9093 in part (GH). SANTA CRUZ: SARA: Cerro del Amboró, 6618 (GH); Buenavista, 450 m., *Steinbach* 6644 (GH); VALLEGRANDE: Cuesta de La Negra, *Steinbach* 3712 (GH).

10. **P. erianthum** Nees in Trin. Gram. Pan. 121 (1826). Perennial, densely caespitose, to 1 m. tall. Leaf-sheaths variably pilose and ciliate; blades sparsely to densely pilose. Panicle of few to several erect racemes, raceme-rachis narrow, not prolonged beyond the uppermost spikelet, not coarsely scabrid-ciliate. Spikelets to 5 mm. long, ovate, acute. Second glume sparsely long-villous, with a marginal fringe of long silky hairs. Sterile lemma more nearly glabrous except at apex. Fertile lemma pale, shining, finely reticulate-striate. SANTA CRUZ: SARA: Buenavista, *Steinbach* 3543 (GH).

11. **P. Buchtienii** Hack. in Fedde, Rep. Sp. Nov. 6: 153 (1908). Caespitose perennial, somewhat straggling, to 10 dm. tall. Leaf-sheaths usually densely long-ciliate, otherwise glabrous; blades to 15 cm. long and 1.5 cm. wide, usually glabrous or glabrate on the upper surface. Panicle of 8-16 purplish racemes to 10 cm. long, neither solitary nor conjugate, the very narrow rachis not extended beyond the uppermost spikelet, not coarsely scabrid-ciliate. Spikelets to 3.5-4 mm. long, second glume present, shortly acuminate, ciliate with a long fringe of stiff white hairs. Sterile lemma glabrous. Fertile lemma shorter than the spikelet. YUNGAS: *Bang* 265 (GH); Puente Villa, 1400 m., *Cárdenas* 3597 (GH). LA PAZ: NOR YUNGAS: Polo-Polo, 1100 m., *Buchtien* 266 (GH), 447 (GH); SUR YUNGAS: Chulumani, 1600 m., *Hitchcock* 22664 (GH); La Florida, 1840 m., *Hitchcock* 22648 (GH).

12. **P. polyphylla** Nees ex Trin. Gram. Pan. 114 (1810). Perennial, to 6 dm. tall. Leaf-sheaths somewhat pilose at the apex, otherwise glabrous; blades to 5 cm. long, about 3 mm. wide, flat to subinvolute, puberulent on both surfaces. Panicle of 1-3 racemes to 7 cm. long, light in color, the narrow rachis not coarsely scabrid-ciliate, not prolonged beyond the uppermost spikelet. Spikelets to 3.5 mm. long,

second glume present, 5-nerved, densely ciliate with long, stiff, white hairs. Sterile lemma 5-nerved, ciliate on at least the upper margin. Fertile lemma as long as the sterile, thin-textured. SANTA CRUZ: VALLEGRANDE: Cuesta de La Negra, 1500 m., *Steinbach* 3718 (GH); SARA: Buenavista, 500 m., *Steinbach* 5385 (GH), 5762 (GH), 6808 (GH).

13. **P. distichum** L. Syst. Nat. (ed. 10) **2:** 855 (1759). Stoloniferous perennial to 6 dm. tall, the nodes pubescent. Leaf-sheaths sparsely hispid-ciliate at the apex, otherwise glabrous; blades subinvolute to flat, to 6 mm. wide, the base sparsely hispid-ciliate, otherwise glabrous. Panicle of 2 conjugate racemes (rarely 3) to 7 cm. long, the rachis not coarsely scabrid-cilate, not prolonged beyond the uppermost spikelets. Spikelets 2.5-3.5 mm. long. First glume often present, but not over 0.5 mm. long; second glume abruptly acute, pubescent to puberulent, the midrib prominent. Sterile lemma similar but glabrous, the midrib prominent. Fertile lemma shorter than spikelet, greenish-white, somewhat shining, often shortly penicillate at the abruptly acute apex. LA PAZ: MURILLO: La Paz, *Buchtien* 4518 (US). COCHABAMBA: CERCADO: Cochabamba, *Hitchcock* 22793 (US). SANTA CRUZ: SARA: Río Surutú, 400 m., *Steinbach* 6835 (GH).

14. **P. decumbens** Swartz, Prodr. 22 (1788). Branched, decumbent perennial, the culms to 6 dm. tall. Leaf-sheaths finely pubescent and densely short-ciliate; blades flat, to 10 cm. long and 8 mm. wide, pubescent on both surfaces, the margins ciliate, at least near the base. Inflorescence a solitary raceme 2-3 cm. long, the narrow rachis not prolonged beyond the uppermost spikelet, not coarsely long-ciliate. Spikelets about 1.5 mm. long, obovate to suborbicular, paired, glabrous. First glume present on one or both spikelets in a pair, very short; second glume rounded, half the length of the spikelet. Sterile lemma similar but usually twice as long. Fertile lemma shining, longitudinally regularly striate, the ridges finely and regularly papillate. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5314 (GH). COCHABAMBA: CHAPARE: Antahuacana, Espíritu Santo, 750 m., *Buchtien s. n.* (GH). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 7016 (GH). YUNGAS: *Bang* 266 in part (at least as to GH sheet).

15. **P. inconstans** Chase in Contrib. U. S. Nat. Herb. **24:** 446 (1927). Perennial, to 8.5 dm. tall, the culms branched above. Leaf-sheaths short-ciliate, pubescent at the apex; blades flat, to 15 cm. long and 1.2 cm. wide, rather densely pubescent on both surfaces. Panicle of 1-8 (usually 2-5) non-conjugate racemes, the narrow rachis not prolonged beyond the uppermost spikelet and not coarsely scabrid-ciliate. Spikelets paired, about 2.5 mm. long. First glume usually present, at least as a rudiment, on the lower of the paired spikelets; second glume shorter than the spikelet, 3(-5)-nerved, the margin puberulent. Sterile lemma somewhat longer, sometimes slightly puberulent on the margin. Fertile lemma somewhat shining, very finely papillate-striate. LA

PAZ: NOR YUNGAS: San José, 1500 m., *Hitchcock* 22734 (GH); SUR YUNGAS: La Florida, 1840 m., *Hitchcock* 22609 (GH).

16. **P. lepidum** Chase in Contrib. U. S. Nat. Herb. **27**: 447 (1927). Densely caespitose perennial, to 4.5 dm. tall, the culms simple. Leaf-sheaths pubescent at the apex, otherwise glabrous to pubescent; blades to 11 cm. long and 1 cm. wide, densely pubescent on both surfaces. Panicle of 3-4 non-conjugate racemes, the narrow rachis not coarsely scabrid-ciliate, not prolonged beyond the uppermost spikelet. Spikelets paired, to 2.4 mm. long. First glume seldom present; second glume 5-nerved, somewhat puberulent or pubescent at the summit. Sterile lemma slightly longer, 5-nerved, glabrous. Fertile lemma very finely papillate-striate. LA PAZ: SUR YUNGAS: San Felipe, 2800 m., *Hitchcock* 22605 (GH).

17. **P. paniculatum** L. Syst. Nat. (ed. 10) **2**: 855 (1759). Perennial, branching, to 1 m. or more in height, the culm-nodes pilose to pubescent. Leaf-sheaths glabrous, ciliate; blades flat, to 30 cm. long and 1.5 cm. wide. Panicle of numerous, crowded, non-conjugate racemes, the narrow rachis not coarsely scabrid-ciliate, not prolonged beyond the uppermost spikelet. Spikelets paired, suborbicular, about 1.2-1.4 mm. long. Second glume present. Sterile lemma pubescent. Fertile lemma minutely papillate-striate. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5323 (GH); NOR YUNGAS: Polo-Polo, 1100 m., *Buchtien* 269 (GH); Milluguaya, 1300 m., *Buchtien* 269 (GH); SUR YUNGAS: La Florida, 1840 m., *Hitchcock* 22624 (GH).

18. **P. Juergensii** Hack. in Fedde, Rep. Sp. Nov. **7**: 312 (1909). Perennial, to 1 m. high, somewhat straggling or decumbent, the nodes dark, often with long hispid hairs. Leaf-sheaths villous-ciliate, often with papillate-based hairs; blades flat, to 20 cm. long and 1.5 cm. wide, long-pubescent above and beneath with papillate-based hairs, or glabrate. Panicle of several lax non-conjugate racemes, rachis of racemes not coarsely scabrid-ciliate, not prolonged beyond the uppermost spikelet. Spikelets paired, to 1.7 mm. long, second glume present, pubescent, rather blunt. Sterile lemma glabrous. Fertile lemma somewhat shining, very finely papillate-striate. YUNGAS: *Bang* 308 (GH).

19. **P. multicaule** Poir. Encycl. Suppl. **4**: 309 (1816). Annual, much-branched from the base, about 1 dm. tall. Leaf-sheaths hispid-ciliate, often pilose; blades narrow, linear, pilose, the margins hispid-ciliate. Panicle of 2 conjugate divergent racemes, rarely 1, or still more rarely 3; raceme-rachis not prolonged beyond the uppermost spikelet, not coarsely scabrid-ciliate. Spikelet suborbicular, 1-1.25 mm. long, second glume present. Glume and sterile lemma with short, clavate to falcate or globose, swollen, transparent, unicellular hairs. Fertile lemma shining, minutely papillate-striate. LA PAZ: LARECAJA: San Carlos, Mapiri, 850 m., *Buchtien* 16 (GH).

20. **P. pictum** Ekman in Ark. Bot. **10** (17): 11 (1911). Annual, somewhat tufted, to 3.5 (-5) dm. tall, the nodes glabrous. Leaf-sheaths

glabrous; blades very narrow, linear, flat to conduplicate, scabridulous above, glabrous beneath or with a few papillate-based hispid hairs. Racemes usually 2 (occasionally 1 or 3), somewhat conjugate; raceme-rachis not prolonged beyond the uppermost spikelet, not coarsely long-ciliate. Spikelets obovoid, to 1 mm. long, glabrous, second glume present. Fertile lemma broader than second glume and sterile lemma, markedly papillate-striate at maturity. SANTA CRUZ: SARA: Buenavista, *Steinbach* 1894 (GH).

21. **P. inaequivalve** Raddi, Agrost. Bras. 28 (1823). Perennial, the culms broadly spreading and rooting at the lower nodes. Leaf-sheaths finely pubescent to glabrous, the hairs papillate-based; blades flat, to 25 cm. long and 1.5 cm. wide, cordate-clasping at the base, sparsely pilose above and beneath with papillate-based hairs. Panicle of few to many spreading non-conjugate racemes, the narrow raceme-rachis not coarsely long-ciliate, not prolonged beyond the uppermost spikelet. Spikelets paired, elliptic, to 2 mm. long. First glume absent or sometimes present on 1 spikelet of the pair, very short; second glume half as long as the spikelet, finely pubescent to glabrous. Sterile lemma finely pubescent or glabrous. Fertile lemma shining, pale green-brown. LA PAZ: NOR YUNGAS: Coripata, *Hitchcock* 22691 (GH).

22. **P. conjugatum** Berg. in Act. Helv. Phys. Math. 7: 129 (1762). Perennial, creeping, the flattened culms to 1 m. high, but usually shorter. Leaf-sheaths densely short-ciliate, with an apical ring of long soft hairs; blades flat, to 20 cm. long and 8 mm. wide, the margins shortly scabrid-ciliate, otherwise usually glabrous. Panicle usually of 2 long (10-12 cm.) arcuate, divaricate, conjugate racemes, rarely a third raceme below; raceme-rachis narrow, not coarsely scabrid-ciliate, not extending beyond the uppermost spikelet. Spikelets to 1.5 mm. long, strongly flattened, suborbicular. First glume absent, second glume thin, with a marginal fringe of long silky hairs. Sterile lemma thin, glabrous. Fertile lemma pale, rather shining. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 6325 (GH); NOR YUNGAS: Polo-Polo, 1100 m., *Buchtien* 268 (GH). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 1862 (GH), 500 m., *Steinbach* 5160 (GH); Dolores, 450 m., *Steinbach* 6836 (GH).

23. **P. dilatatum** Poir. Encycl. 5: 35 (1804). Perennial, to 1.5 m. tall, from a short rhizomatous base. Leaf-sheaths sometimes pilose at the base, otherwise glabrous, ciliate near the apex; blades flat, to 2.5 dm. long and 1.2 cm. wide, the base somewhat ciliate. Panicle usually of 3-5 non-conjugate racemes, the narrow rachis not prolonged beyond the uppermost spikelet, the margin not coarsely scabrid-ciliate. Spikelets to 3.8 mm. long, ovoid, acute. First glume absent, second glume covered with long silky hairs, especially dense along the margin. Sterile lemma slightly shorter than the second glume, the margin not densely silky. Fertile lemma pale, finely papillate-striate. TARIJA: CERCADO: Tarija, 2000 m., *Cárdenas* 202 (GH).

24. **P. Urvillei** Steud. Syn. Pl. Glum. **1:** 24 (1854). Stout perennial, to 2.5 m. tall. Leaf-sheaths hirsute, ciliate, or the upper sheaths glabrous; blades to 4.5 dm. long, pilose at the base, otherwise glabrous. Panicle of numerous, ascending, non-conjugate racemes, the raceme-rachis narrow, margin scabrid but not coarsely scabrid-ciliate, not prolonged beyond the uppermost spikelet. Spikelets to 2.5 mm. long, ovoid, obtuse. Second glume and sterile lemma with many long silky hairs on the margin, the glume sparsely hairy on the back, the lemma glabrous on the back. Fertile lemma pale, smooth or nearly so. LA PAZ: LARECAJA: Sorata, *Gunther* (US).

25. **P. notatum** Flügge, Monogr. Pasp. 106 (1810). Perennial, from a short rhizome, to 5 dm. tall. Leaf-sheaths ciliate at the apex, otherwise glabrous; blades flat, to 3 dm. long and 1 cm. wide, ciliate at the base, otherwise glabrous. Panicle of 2 divergent racemes, conjugate or nearly so (rarely a third raceme present); raceme-rachis narrow, glabrous, not extended beyond the uppermost spikelet. Spikelets unpaired, glabrous, obovoid to ovoid, about 3 mm. long. Second glume present, as long as the sterile lemma, firm-textured. Fertile lemma rather indurate, finely papillate-striate. SANTA CRUZ: SARA: Dolores, 450 m., *Steinbach* 1833 (GH); Buenavista, 450-500 m., *Steinbach* 5273 (GH), 7020 (GH). TARIJA: O'CONNOR: near Entre Rios, 1300 m., *West* 8249 (GH).

26. **P. minus** Fourn. Mex. Pl. **2:** 6 (1886). Densely matted perennial, to 3 dm. high. Leaf-sheaths mostly glabrous, long-ciliate. Panicle of 2 conjugate or nearly conjugate racemes (occasionally 3); raceme-rachis narrow, not prolonged beyond the uppermost spikelet, not coarsely scabrid-ciliate. Spikelets solitary, glabrous, to 2.5 mm. long, broadly ovoid, subobtuse. Second glume present, sterile lemma similar but slightly shorter, both with prominent green midribs. Fertile lemma shorter, pale, somewhat shining, finely striate. LA PAZ: LARECAJA: San Carlos, *Buchtien* 79 (US).

27. **P. melanospermum** Desv. in Encycl. Suppl. **4:** 315 (1816). Spreading annual, culms to 7 dm. long, the bases decumbent. Leaf-sheaths glabrous; blades flat or folded, to 15 cm. long and 1 cm. wide, pilose at the base on the upper surface, otherwise glabrous. Panicle of 2-7 non-conjugate racemes; raceme-rachis very narrow, not coarsely scabrid-ciliate, not extended beyond the uppermost spikelet. Spikelets usually paired, to 2 mm. long, obovoid. Second glume present, thin, somewhat strigose; sterile lemma thin, the margin wrinkled. Fertile lemma dark-brown and shining, obscurely striate. SANTA CRUZ: SARA: Buenavista, *Steinbach* 5459 (GH).

28. **P. plicatulum** Michx. Fl. Bor.-Am. **1:** 45 (1803). Perennial, 0.5-1 m. tall. Leaf-sheaths usually glabrous but papillate-hispid on the margins; blades to 5 dm. long and 1 cm. wide, papillate-pilose at the base of the upper surface. Panicle of several to many non-conjugate racemes; raceme-rachis narrow, not coarsely scabrid-ciliate, not

extended beyond the uppermost spikelet. Spikelets paired, to 3 mm. long, obovoid. Second glume present, thin, sparsely appressed-pubescent (occasionally glabrous). Sterile lemma thin, glabrous, transversely rugulose near the base. Fertile lemma dark chestnut-brown, shining, striate. LA PAZ: NOR YUNGAS: Coripata, *Hitchcock* 22675 (GH). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 1829 (GH), 1869 (GH), 6873 (GH), 6887 bis (GH), 7036 (GH).

29. **P. collinum** Chase in Contrib. U. S. Nat. Herb. **27:** 451 (1927). Perennial, to 6.5 dm. tall. Leaf-sheaths glabrous, with a few marginal hairs near the apex; blades flat, to 2 dm. long and 9 mm. wide, rather sparsely long-ciliate. Panicle of 4 distant ascending racemes 2-6 cm. long, the raceme-rachis about 0.7 mm. wide, not coarsely scabrid-ciliate, not prolonged beyond the uppermost spikelet. Spikelets paired, pedicellate, the pedicels glabrous, to 2.5 (-2.7) mm. long. Second glume shortly appressed-pubescent. Sterile lemma more sparsely pubescent than the glume, 5-nerved. Fertile lemma dark brown, papillate-striate, shining. LA PAZ: NOR YUNGAS: Coroico, 1560 m., *Hitchcock* 22723 (US; type).

30. **P. virgatum** L. Syst. Nat. (ed. 10) **2:** 855 (1759). Stout perennial, to 1-2 m. tall. Leaf-sheaths papillate-hirsute on the margins and at the apex; blades flat, to 7.5 dm. long and 2.5 cm. wide, upper surface papillate-hirsute at the base. Panicle of several to many racemes; raceme-rachis narrow, not prolonged beyond the uppermost spikelet, margin scabrid-ciliate, with scattered, long, hispid hairs. Spikelets paired, to 2.5 mm. long, obovoid. Second glume with long silky hairs around margin. Sterile lemma puberulent to glabrous. Fertile lemma shining chestnut-brown, papillate-striate. LA PAZ: LARECAJA: San Carlos, Mapiri, 850 m., *Buchtien* 52 (GH); NOR YUNGAS: Hacienda El Choro, Coripata, 1700 m., *Buchtien* 8044 (GH).

31. **P. conspersum** Schrad. ex Schult. Mant. **2:** 174 (1817). Perennial, to 1.2 m. tall. Leaf-sheaths glabrous or papillate-pilose; blades sometimes subcordate at the base, flat, sometimes papillate-pubescent on the upper surface. Panicle of several (to 16) non-conjugate racemes; raceme-rachis narrow, the margin scabridulous to scabrid, but without long hispid hairs, not prolonged beyond the uppermost spikelet. Spikelets paired, to 3 mm. long, ellipsoid, acute. Second glume and sterile lemma thin, 5-nerved, one or both shortly pubescent. Fertile lemma chestnut-brown, papillate-striate. LA PAZ: NOR YUNGAS: Coripata, *Hitchcock* 22696 (US).

32. **P. millegrana** Schrad. ex Schult. Mant. **2:** 175 (1824). Stout perennial, 1-2 m. tall. Leaf-sheaths glabrous or with a few hairs near the apex; blades folded, to 7.5 dm. long and 1.5 cm. wide, the upper surface often papillate-pubescent. Panicle of several to many non-conjugate racemes to 1.5 dm. long; raceme-rachis coarsely scabrid-serrate and sparsely hispid-ciliate, not prolonged beyond the uppermost spikelet. Spikelets paired, obovoid to suborbicular, glabrous, to

2.5 mm. long. Second glume and sterile lemma firm, 3-nerved. Fertile lemma pale, finely papillate-striate. BENI: YACUMA: Reyes, *Cárdenas* (M. E.) 1656 (Hitchcock).

33. **P. densum** Poir. Encycl. 5: 32 (1804). Stout perennial, to 1.2 m. tall. Leaf-sheaths glabrous, or the margin ciliate, or somewhat pubescent to hirsute at the apex; blades folded, often to 1 m. long and 2 cm. wide, but generally shorter and narrower. Panicle of many non-conjugate racemes; raceme-rachis narrow, not prolonged beyond the uppermost spikelet, coarsely scabrid and densely hispid-ciliate. Spikelets paired, suborbicular, to 2.2 mm. long, glabrous. Second glume and sterile lemma 3-nerved, thin. Fertile lemma pale, shining, finely papillate-striate. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 3264 (GH), 6898 (GH).

34. **P. remotum** Remy in Ann. Sci. Nat. (ser. 3) Bot. 6: 349 (1846). Perennial, decumbent to 10 dm. tall, glabrous. Leaf-blades to 2 dm. long and 1 cm. wide, the margins strongly scabrous. Panicle of 2-5 non-conjugate racemes; raceme-rachis narrow, not coarsely scabrid-ciliate, not prolonged beyond the uppermost spikelet. Spikelets paired, to 3.2 mm. long, ovoid. Second glume and sterile lemma green, pubescent, the glume 5-nerved, the lemma 3-nerved. Fertile lemma pale, shining, finely papillate-striate. LA PAZ: LARECAJA: Sorata, *Mandon* 1252 (GH), *Bang* 1312 (GH). COCHABAMBA: CERCADO: Cochabamba, *Hitchcock* 22807 (GH); Mollemolle, 2800 m., *Steinbach* 4055 (GH).

35. **P. pilosum** Lam. Tabl. Encycl. 1: 175 (1791). Perennial, somewhat tufted, to 11.5 dm. tall, usually shorter. Leaf-sheaths papillate-pubescent to glabrous, with ciliate margins; blades flat, to 4 dm. long and 8 mm. wide, pubescent above and beneath, margins and base often with papillate-hispid hairs. Racemes solitary, to 15 cm. long, the narrow rachis with few to many papillate-based hispid hairs, not prolonged beyond the uppermost spiketlet. Spikelets paired, glabrous, ovoid, to 3 mm. long. First glume small to minute; second glume 5-nerved, firm, shorter than mature fruit. Sterile lemma 5-nerved, firm. Fertile lemma pale, markedly papillate-striate. LA PAZ: LARECAJA: San Carlos, Mapiri, 850 m., *Buchtien* 15 (GH).

36. **P. Ekmanianum** Henr. in Meded. Rijks Herb. Leiden, no. 40: 49 (1921). Perennial, to 6 dm. tall. Leaf-sheaths ciliate; blades to 1 dm. long, the upper surface papillate-pilose. Racemes solitary (very rarely 2 racemes on a culm), the narrow rachis not prolonged beyond the uppermost spikelet, not coarsely scabrid-ciliate. Spikelets paired, oblong-ellipsoid, to 2 mm. long. Second glume and sterile lemma covered with white hairs of varying lengths, the longest more than twice the length of the spikelet. Fertile lemma pale, rather shining, smooth. SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 1818 (GH), 5320 (GH), 6923 (GH).

37. **P. malacophyllum** Trin. Gram. Pan. Icon. 3: t. 271 (1831). Perennial, to 1-2 m. tall. Leaf-sheaths sparsely papillate-pilose;

blades to 25 cm. long and 2.5 cm. wide, densely to sparsely pubescent beneath. Panicle of numerous non-conjugate racemes; raceme-rachis narrow, sparsely ciliate, not prolonged beyond the uppermost spikelet. Spikelets paired, mostly less than 2 mm. long, often purplish, glabrous. Glumes absent, sterile lemma firm, midrib prominent. Fertile lemma often purplish, strongly ribbed, papillate-striate. LA PAZ: LARECAJA: Hacienda Casana, *Buchtien* 7110 (US).

38. **P. boliviense** Chase in Contrib. U. S. Nat. Herb. **24**: 454 (1927). Perennial, 1-1.5 m. high. Leaf-sheaths pubescent or pilose at the base, otherwise glabrous; blades flat, to 2 dm. long and 2 cm. wide, margins scabrid, occasionally a few long hairs near the base, otherwise glabrous. Panicle of numerous non-conjugate racemes; raceme-rachis puberulent, narrow, not prolonged beyond the uppermost spikelet. Spikelets paired, usually purplish, mostly over 2 mm. long, glabrous. Glumes absent. Sterile lemma with a prominent midrib. Fertile lemma strongly 7-nerved, strongly papillate-striate. LA PAZ: LARECAJA: Sorata, *Bang* 1306 (GH; type-number); prope Munaypata, Cerro del Iminapi, 2650 m., *Mandon* 1253 (GH). COCHABAMBA: CERCADO: Cochabamba, *Hitchcock* 22866 (US).

39. **P. saccharoides** Nees in Trin. Gram. Icon. **1**: t. 107 (1828). Perennial, stoloniferous, to 1.2 m. high. Leaf-sheaths usually glabrous, sometimes papillate-pilose or papillate, densely ciliate; blades flat, to 3 dm. long and 1.5 cm. wide, the upper surface papillate-pilose, the lower surface glabrous. Panicle of many slender drooping racemes, more or less flabellately arranged; raceme-rachis very narrow, hardly winged, prolonged beyond the uppermost spikelet. Spikelets solitary, distant, lanceolate, acute or acuminate, to 3 mm. long. Second glume often puberulent on the back, marginal fringe of long white hairs, mixed with shorter hairs. Sterile lemma thin, glabrous, shorter than the glume. Fertile lemma thin, not indurate. LA PAZ: LARECAJA: San Carlos, Sarampiuni (Mapiri), 500 m., *Buchtien* 65 (GH); NOR YUNGAS: Coripata, *Hitchcock* 22686 (GH).

82. **Panicum** L.

Annual or perennial; leaf-blades not or barely reaching the inflorescence, rarely exceeding it, linear to lanceolate to elliptic-oblong, acute, glabrous or variously pubescent. Inflorescence a simple to complex panicle, with spikelets from densely racemose on the branches to remote and solitary at the ends of the branchlets. Spikelets pedicellate, disarticulating below the 2 glumes; 2-flowered, the lower floret a sterile lemma (2 sterile lemmas in *P. quadriglume*), or sometimes a staminate floret, the upper floret perfect; fruit indurate or chartaceous-indurate, the lemma-margins inrolled and partly concealing the similar palea.

a. Inflorescence simple, a central axis with the primary branches densely flowered one-sided racemes.

b. Primary branches unbranched, short, very densely flowered.
c. Spikelets hispidulous to hispid.
d. Sterile lemma with 2 crateriform glands; fruit not rugose. ..... 16. *P. pulchellum.*
d. Sterile lemma glandless; fruit rugose. .... 1. *P. echinulatum.*
c. Spikelets glabrous.
e. Longest leaf-blades not over 5 cm. long and 2 mm. wide. ..... 14. *P. stoloniferum.*
e. Longest leaf-blades 9-15 cm. long and 1.5-2 cm. wide.
f. Inflorescence-axis pilose with long hairs; second glume 1.5 mm. long. ..... 11. *P. pilosum.*
f. Inflorescence-axis puberulous to short-pubescent, but not pilose; second glume over 2 mm. long. ..... 15. *P. frondescens.*
b. Primary branches branched, usually from the base, less densely flowered.
g. Stem-nodes pubescent to hirsute. ..... 10. *P. polygonatum.*
g. Stem-nodes glabrous.
h. Longest leaf-blades to 20 cm. long and 1.4 cm. wide, basally cordate and subpetiolate. ..... 13. *P. boliviense.*
h. Longest leaf-blades to 10 cm. long and 1 cm. wide, basally not cordate nor subpetiolate. ..... 12. *P. laxum.*
a. Inflorescence complexly branched, not composed of one-sided racemes; if racemose, the racemes not one-sided and the spikelets not densely crowded.
i. Spikelets not solitary at ends of branchlets.
j. Spikelets hirsutulous to long-hirsute.
k. Spikelets 5.5-7 mm. long; fruit rugose. ..... 29. *P. paucispicatum.*
k. Spikelets 4 mm. long or less; fruit not rugose.
l. Spikelets long-hirsute, 3.5-4 mm. long. .. 32. *P. procurrens.*
l. Spikelets hirsutulous, about 2 mm. long. ..... 26. *P. pantrichum.*
j. Spikelets glabrous.
m. Primary panicle-branches (except at uppermost nodes) in verticils. ..... 30. *P. megiston.*
m. Primary panicle-branches not in verticils (except sometimes at the lowest node only).
n. First glume 1 mm. or less. ..... 2. *P. aquaticum.*
n. First glume 2-3 mm.
o. Leaf-blades to 10 cm. long and 1 cm. wide. ..... 27. *P. cordovense.*
o. Leaf-blades to 20 cm. long and 4 mm. wide. ..... 9. *P. tricholaenoides.*
i. Spikelets remote, solitary at ends of branches, or appearing so.
p. Spikelets minutely puberulent to sparsely hispidulous.

q. Inflorescence-axis glabrous; first glume less than 0.5 mm. long. ..... 17. *P. trichanthum.*
q. Inflorescence-axis not glabrous; first glume 1-2 mm. long.
r. Spikelets 2 mm. long; axis and branches pilose below. ..... 25. *P. sciurotis.*
r. Spikelets 3.5 mm. long; axis and branches hirsute-hispid below. ..... 23. *P. Rudgei.*

p. Spikelets glabrous.
s. Spikelets 6-8 mm. long. ..... 31. *P. olyroides.*
s. Spikelets less than 5 mm. long.
t. Spikelets with 2 sterile lemmas. ..... 7. *P. quadriglume.*
t. Spikelets with 1 sterile lemma.
u. Fruit rugose or rugulose.
v. Second glume to 3.5 mm. long; fertile lemma 2.5 mm. long, rugose. ..... 8. *P. maximum.*
v. Second glume 2 mm. long; fertile lemma 2 mm. long, rugulose. ..... 24. *P. Sellowii.*

u. Fruit not rugose nor rugulose.
w. Leaf-sheaths papillate-pilose.
x. Spikelets 3-4 mm. long.
y. Spikelets 3.5-4 mm. long, acute; first glume 1 mm. long. ..... 5. *P. stramineum.*
y. Spikelets 3 mm. long, acute to acuminate; first glume 1.5-2 mm. long. ..... 6. *P. peladoënse.*
x. Spikelets not over 2.5 mm.
z. First glume 1.5 mm. long; leaf-blade to 1 cm. wide; fertile lemma about 1.5 mm.
A. Leaf-blades pilose above and beneath. ..... 3. *P. cayennense.*
A. Leaf-blade glabrous above, pubescent to glabrate beneath. ..... 4. *P. hirticaule.*
z. First glume 1 mm. long; leaf-blade to 1.5 cm. wide; fertile lemma about 2 mm. long. ..... 24. *P. hebotes.*

w. Leaf-sheaths glabrous; or, if somewhat pubescent, not papillate-pilose.
B. Glumes distinctly unequal.
C. First glume 1 mm. long; leaf-blades 4 mm. wide, not cordate at base. ..... 19. *P. cyanescens.*
C. First glume 0.5 mm. long; leaf-blades to 1 cm. wide, cordate-clasping at base. ..... 20. *P. nervosum.*

B. Glumes subequal or nearly so.
D. Spikelets viscid-glutinous. .... 18. *P. glutinosum.*
D. Spikelets not viscid-glutinous.
E. Leaf-blades about 2 cm. long. ..... 22. *P. parvifolium.*

E. Leaf-blades to 20 cm. long. .... 28. *P. versicolor.*

1. **Panicum echinulatum** Mez in Notizbl. **7:** 62 (1917). *P. echinulatum* var. *boliviense* Henr. in Meded. Rijks Herb. Leiden, no. **40:** 50 (1921). Annual, spreading, culms to 3.5 dm. high. Leaf-sheaths pubescent along the margins, otherwise glabrous; blades lanceolate, acute, to 11 cm. long and 1.4 cm. wide, firm-textured, the thickened margins undulate and ciliolate, glabrous above and beneath. Panicles less than 10 cm. long, axis, branches and pedicels glabrous, scabridulous on the margins. Spikelets to 4 mm. long, usually about 3.5 mm., acute, hispid. Glumes very unequal; first glume broadly ovate, abruptly acute, to 1.5 mm. long, 3-nerved; second glume 3.5 mm. long, acute, 5-nerved. Sterile lemma as long as second glume and similar in appearance. Fertile lemma shorter than the sterile lemma, subobtuse, indurate, transversely rugose. TARIJA: ENTRE RIOS: Villa Montes, *Pflanz* 607 (Hitchcock). SANTA CRUZ: CERCADO: Santa Cruz, 450 m., *Steinbach* 5259 (GH).

2. **P. aquaticum** Poir. Encycl. Suppl **4:** 281 (1816). Perennial, often decumbent and spreading, in wet places or actually in water, the culms to 10 dm. tall. Leaf-sheaths glabrous, the lance-linear blades to 25 cm. long and 1 cm. wide, acute, glabrous. Panicle to 25 cm. long at maturity, the branches somewhat erect but spreading, axis, branches and pedicels glabrous, their margins sometimes scabridulous. Spikelets glabrous, acute, to 3 mm. long. Glumes quite unequal; first glume 1 mm. long, or less, truncately acute, broadly clasping at the base, 1-nerved; second glume 3 mm. long, acute, about 9-nerved. Sterile lemma similar to second glume, slightly shorter and fewer-nerved. Fertile lemma about 2 mm. long, acute, shining, longitudinally striatulate. SANTA CRUZ: SARA: Buenavista, *Steinbach* 3180 (GH).

2a. **P. aquaticum** var. **chloroticum** (Nees ex Trin.) R. C. Foster, comb. nov. *P. chloroticum* Nees ex Trin. Gram. Pan. 236 (1826). Sympatric with and similar in all respects to *P. aquaticum* except for smaller spikelets, 2-2.5 mm. long. BENI: YACUMA: Reyes, *Rusby* (M. E.) 1636 (US).

3. **P. cayennense** Lam. Encycl. Tabl. **1:** 173 (1791). Annual, erect, the culms to 5 dm. tall. Leaf-sheaths papillate-pilose, the linear blades to 16 cm. long and 1 cm. wide, pilose above and beneath. Panicles to 20 cm. long, rather open, the axis hispid-pilose, branches and pedicels glabrous, the margins scabridulous. Spikelets to 2.5 mm. long, usually a little less, glabrous, somewhat acute. Glumes unequal; first glume nearly 1.5 mm. long, acute, 5-nerved; second glume a little over 2 mm. long, acute, 7-nerved. Sterile lemma as long as second glume, 5-nerved. Fertile lemma 1.5 mm. long, obtuse, firm, longitudinally striatulate. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 6935 (GH).

4. **P. hirticaule** Presl, Rel. Haenk. **1:** 308 (1830). Annual, spread-

ing, the culms usually less than 5 dm. tall. Leaf-sheaths variably hispid, but mostly papillate-pilose, the blades lance-linear, to 15 cm. long and 8 mm. wide, variably hispid to pubescent or glabrate beneath. Panicle open, to 15 cm. long, usually shorter, axis and main branches sparsely long-hispid, branchlets and pedicels scabridulous on the margins. Spikelets about 2.5 mm. long, acute, glabrous. Glumes unequal; first glume 1.5 mm. long, acute, 3-5-nerved, the nerves not anastomosing; second glume about 2.5 mm. long or a little shorter, 7-nerved. Sterile lemma about 2.5 mm. long. Fertile lemma about 1.5 mm. long, shining, warm brown, longitudinally striatulate. BENI: CERCADO MOJOS: Trinidad, 200 m., *Cárdenas* 3534 (GH). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 7086 bis (GH).

5. **P. stramineum** Hitchc. & Chase in Contrib. U. S. Nat. Herb. **15:** 67 (1910). Annual, erect or spreading, the culms to 5 dm. tall but usually shorter. Leaf-sheaths usually papillate-pilose, but sometimes almost glabrous, the lance-linear blades to 20 cm. long and 8 mm. wide, glabrous to sparsely pilose, at least beneath, the margins sparsely long-ciliate to glabrous. Panicle open, about 15 cm. long, axis, branches and pedicels glabrous but scabridulous on the margins. Spikelets 3.5-4 mm. long, glabrous, acute. Glumes very unequal; first glume about 1 mm. long, obtuse or abruptly acute, 3-5-nerved, the nerves anastomosing; second glume 3 mm. long, acute, many-nerved. Sterile lemma as long as or slightly longer than the second glume, subobtuse, many-nerved. Fertile lemma about 2.5 mm. long, shining, firm-textured. BENI: YACUMA: Reyes, *Cárdenas* (M. E.) 1647 (US).

6. **P. peladoënse** Henr. in Blumea, 4(3): 504 (1941). Perennial, to 4 dm. tall. Leaf-sheaths papillate-pilose; blades scabridulous-puberulent above and beneath, sparsely papillate-hirsute above and beneath, the long hairs hispid, blade to 4 mm. wide. Panicle to 12 cm. long, axis and branches glabrous, branchlets and pedicels scabridulous. Spikelets glabrous, acute to acuminate, 3 mm. long. Glumes unequal; first glume ovate, 1.5-2 mm. long, subacute, 5-nerved; second glume 2.5-3 mm. long, 5-nerved, acute. Sterile lemma about 3 mm. long, or slightly longer, acute to acuminate. Fertile lemma about 2 mm. long, dark-brown, shining, obtuse. SANTA CRUZ: VALLEGRANDE: Cuesta de los Monos, 1400 m., *Herzog* 1896j (cited in original description; not seen).

The only material of this species which has been seen is an isotype, *Balansa* 4357, in the United States National Herbarium. The description is based entirely on this. Since no Bolivian material has been seen in two large herbaria, it is possible that the attribution of the species to Bolivia rests on a misdetermination.

7. **P. quadriglume** (Doell) Hitchc. in Contrib. U. S. Nat. Herb. **24:** 460 (1927). Perennial, the culms to 4 dm. tall, the nodes densely

pilose. Leaf-sheaths papillate-pilose, blades to 20 cm. long and 5 mm. wide, linear, pilose above and beneath. Panicle rather open at maturity, to 15 cm. long, axis, branches and pedicels glabrous, the branches and pedicels scabridulous on the margins. Spikelets to 3 mm. long, glabrous, acute, with 2 sterile lemmas. Glumes unequal; first glume 1.5 mm. long, broad, acute, 5-nerved, the lateral nerves more or less anastomosing; second glume 2.5 mm. long, 7-nerved. Sterile lemmas 3 mm. long, about 7-nerved. Fertile lemmas about 2 mm. long, firm-textured, shining, dark brown (paler in immaturity). LA PAZ: NOR YUNGAS: Milluguaya, 1100 m., *Buchtien* 4174 (GH). SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 5299 (GH), 7076 bis (GH), 6979 (at least as to GH sheet).

8. **P. maximum** Jacq. Coll. Bot. 1: 76 (1786). Perennial, to 2 m. tall, culms with pubescent to somewhat hirsute nodes. Leaf-sheaths glabrous to sparsely papillate-hirsute, blades to 30 cm. long and 7 mm. wide, linear, glabrous above and beneath. Panicle open, to 3.5 dm. long, axis, branches and pedicels glabrous, the branches often shortly pubescent at the very base. Spikelets to 3.5 mm. long, glabrous, acute. Glumes unequal; first glume 1.5 mm. long, rather obtuse, obscurely nerved; second glume to 3.5 mm. long, about 7-nerved, the nerves rather obscure. Sterile lemma about as long as the second glume, 7-nerved. Fertile lemma 2.5 mm. long, strongly rugose, the apex often minutely puberulent. LA PAZ: NOR YUNGAS: Milluguaya, 1200 m., *Buchtien* 442 (in 1917) (GH); Polo-Polo, near Coroico, 1100 m., *Buchtien* 442 (in 1912) (GH).

9. **P. tricholaenoides** Steud. Syn. Pl. Glum. 1: 68 (1854). ? *P. giganteum* O. Ktze. Rev. Gen. 3(2): 360 (1898). Perennial, slender, erect, rhizomatous, the culms to 1 m. tall. Leaf-sheaths glabrous, the glabrous linear blades to 20 cm. long and 4 mm. wide, often inrolled. Panicle rather narrow, to 20 cm. long, the branches erect to rather spreading, axis glabrous, branches scabrid on the margins, the ultimate pedicels often ciliate with long stiff hairs, a group of such hairs often subtending the spikelets. Spikelets to 3 mm. long, glabrous, acute. Glumes unequal; first glume to 2 mm. long, rather narrowly acute, 3-nerved; second glume as long as the spikelet, 5-7-nerved. Sterile lemma shorter than second glume, obscurely nerved. Fertile lemma less than 2 mm. long, somewhat obtuse, shining, firm. SANTA CRUZ: SARA: Buenavista, campos de Dolores, 450 m., *Steinbach* 3220 (GH).

10. **P. polygonatum** Schrad. ex Schult. Mant. 2: 256 (1824). Perennial, somewhat sprawling, the culms 2-6 dm. tall, the nodes pubescent to hirsute. Leaf-sheaths ciliate, the lanceolate blades to 20 cm. long and 2 cm. wide, pilose above and beneath, at least when young, long-acute, the base subcordate and often subpetiolate. Panicle spreading, to 2.5 dm. long, the spikelets unilateral on the branches, the axis and branches scabridulous and sparsely hispid, the pedicels scabri-

dulous. Spikelets about 1.5 mm. long, acute, glabrous. Glumes unequal; first glume 1 mm. long, 1-nerved, the nerve apically scabridulous, acute; second glume as long as the spikelet, 5-nerved. Sterile lemma shorter than second glume, about 3-nerved. Fertile lemma 1 mm. long or slightly longer, acute, shining. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5334 (GH); San Carlos, Mapiri, 850 m., *Buchtien* 74 (GH). SANTA CRUZ: SARA: Buenavista, 400 m., *Steinbach* 5231 (GH); Río Surutú, 500 m., *Steinbach* 6840 (GH).

11. **P. pilosum** Swartz, Prodr. 22 (1788). Spreading to ascending perennial, the culms to 6 dm. tall. Leaf-sheaths long-ciliate on the margins, otherwise glabrous to slightly pilose, the broadly linear blades to 15 cm. long and 1.5 cm. wide, usually glabrous beneath, scattered-pilose above, acute, abruptly rounded at the base. Panicle to 15 cm. long, the main axis glabrous or somewhat puberulent, the primary branches with long stiff hairs much exceeding the spikelets, pedicels glabrous to subpuberulous, the component racemes short (seldom more than 3 cm. long), densely flowered, ascending to somewhat spreading, usually arranged in verticils. Spikelets about 1.5 mm. long, subacute. Glumes unequal; first glume 1 mm. long, 3-nerved; second glume as long as the spikelet, 5-nerved. Sterile lemma like second glume, but sometimes slightly shorter, rather blunt, obscurely 5-nerved. Fertile lemma shorter than sterile, indurate, shining. LA PAZ: LARECAJA: San Carlos, Mapiri, 750 m., *Buchtien* 78 (GH).

12. **P. laxum** Swartz, Prodr. 23 (1788). Perennial, basally decumbent or spreading, culms 2-6 dm. tall. Leaf-sheaths densely ciliate, blades to 10 cm. long and 1 cm. wide, lanceolate, acute, the base abruptly contracted, glabrous above and beneath. Panicle fairly open, to 2 dm. long, the branches spreading and branched, the numerous spikelets unilaterally arranged, axis, branches and pedicels glabrous but the margins scabridulous. Spikelets to 1.5 mm. long, acute, glabrous. Glumes unequal; first glume less than 1 mm. long, 1-nerved, acute; second glume as long as the spikelet, 5-nerved. Sterile lemma as long as second glume, several-nerved, rather obtuse. Fertile lemma about 1 mm. long, shining. YUNGAS: *Bang* 308a (GH). LA PAZ: LARECAJA: Charopampa, 570 m., *Buchtien* 1168 (GH); San Carlos, 750 m., *Buchtien* 1179 (GH); Hacienda Simaco, 1400 m., *Buchtien* 5315 (GH). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 2064 (GH), 5161 (GH), 5338 (GH), 6850 (GH); VALLEGRANDE: Comarapa, Yungas de San Mateo, 2500 m., *Steinbach* 8508 (GH).

13. **P. boliviense** Hack. in Fedde, Rep. Sp. Nov. 11: 19 (1912). Perennial, decumbent to spreading, the culms to 3-5 dm. tall. Leaf-sheaths ciliate, blades lanceolate to lance-oblong or occasionally lance-linear, to 20 cm. long and 1.4 cm. wide, rather long-acute, the base cordate to subcordate and subpetiolate, glabrous above and beneath. Panicle quite open at maturity, to 20 cm. long, axis, branches and pedicels often scabridulous on the margins, the lower primary branches

sometimes sparsely hispid in the axils, the spikelets more loosely arranged than in *P. laxum*. Spikelets 1.5 mm. long, acute or subobtuse, glabrous. Glumes unequal; first glume about 0.75 mm. long, 1-nerved or rather obscurely 3-nerved; second glume as long as the spikelet, 5-nerved. Sterile lemma as long as second glume, 5-nerved, subobtuse. Fertile lemma slightly longer than 1 mm., subobtuse, not markedly shining but rather dull, obscurely 3-nerved, longitudinally striatulate. SANTA CRUZ: SARA: Buenavista, 400-450 m., *Steinbach* 6857 (US, GH), 6944 bis (GH). COCHABAMBA: CHAPARE: Antahuacana, *Buchtien* 2501 (US; type-number).

14. **P. stoloniferum** Poir. Encycl. Suppl. **4**: 274 (1816). Perennial, creeping and spreading, the flowering culms to 3 dm. tall. Leaf-sheaths pubescent, at least sparsely so, blades lanceolate, to 3.5-4 cm. long and 5 mm. wide, puberulent above and beneath, at least when young, acute, abruptly narrowed at the base and usually subpetiolate. Panicle small, occasionally to 5 cm. long, the component racemes seldom over 1 cm. long, axis glabrous or nearly so, branches and pedicels glabrous to somewhat puberulous. Spikelets 2.5-3 mm. long, acute, glabrous. Glumes very unequal; first glume 1 mm. long, or slightly longer, 3-nerved, the central nerve prominent; second glume 2.5 mm. long, 5-nerved. Sterile lemma about 3 mm. long, 5-nerved. Fertile lemma 1.5 mm. long, indurate, shining, acute, obscurely nerved, not rugose. LA PAZ: LARECAJA: Mapiri, *Buchtien* 1167 (US).

15. **P. frondescens** Meyer, Primit. Fl. Esseq. 56 (1818). Annual (?), decumbent, rooting at the nodes, the flowering culms to 3 or even 5 dm. tall. Leaf-sheaths ciliate, blades to 9-10 cm. long and 2 cm. wide, lance-ovate, acuminate, the wide base abruptly narrowed and shortly petiolate, scabridulous above and beneath. Panicles to 13 cm. long, main axis puberulent to pubescent, branches and pedicels glabrous. Spikelets to 3 mm. long, usually shorter, acute, glabrous. Glumes very unequal; first glume 1 mm. long, broadly ovate, abruptly acute, rather obscurely 3-nerved, the midrib scabridulous above; second glume to 2.25 mm. long, shorter than the spikelet, acute, 5-nerved. Sterile lemma similar to second glume but 2.5-3 mm. long. Fertile lemma about 1.5 mm. long, narrow, acute, indurate, shining, smooth. LA PAZ: NOR YUNGAS: Polo-Polo, near Coroico, 1100 m., *Buchtien* 264 (GH), 1173 (GH). SANTA CRUZ: SARA: Buenavista, 400 m., *Steinbach* 5130 (GH), 6855 (GH).

16. **P. pulchellum** Raddi, Agrost. Bras. 42 (1823). Slender spreading perennial, the flowering culms to 2-3 dm. tall. Leaf-sheaths shortly ciliate, the blades lance-ovate, to 6 cm. long and 1.7 cm. wide, basally subcordate, glabrous above, sometimes sparsely puberulent beneath. Panicle to 10-11 cm. long, the branches remote, axis and branches sparsely pubescent to hispidulous, the pedicels mostly glabrous. Spikelets to 2.5 mm. long, from nearly glabrous to hispidulous or hispid, acute. Glumes unequal; first glume 1 mm. or slightly less,

ovate, acute, 3-nerved; second glume 2 mm. long, ovate, acute, 5-nerved. Sterile lemma about 2 mm. long, long-acute, 5-nerved. Fertile lemma 1.5 mm. long, chartaceous, shining, not rugose. LA PAZ: SUR YUNGAS: Guanay, *Rusby* 217 (US).

17. **P. trichanthum** Nees, Agrost. Bras. 210 (1829). Straggling perennial, the culms to 1 m. tall. Leaf-sheaths long-ciliate, otherwise glabrous, blades to 15 cm. long and 2 cm. wide (rarely wider), sparsely to densely pubescent above and beneath, at least when young, lanceolate, acute, basally abruptly rounded and somewhat clasping. Panicle large, diffuse, to 20 cm. long, axis, branches and pedicels glabrous. Spikelets minutely puberulous to glabrous, solitary, to 1.5 mm. long. Glumes very unequal; first glume less than 0.5 mm. long, white-papery, not obviously nerved; second glume as long as the spikelet, 5-nerved. Sterile lemma as long as second glume and similar in appearance. Fertile lemma less than 1.5 mm. long, indurate, not rugose, shining. LA PAZ: NOR YUNGAS: Coroico, *Buchtien* 445 (GH), 446 (US); SUR YUNGAS: Chulumani, *Hitchcock* 22660 (US). SANTA CRUZ: CORDILLERA: Puerto Suarez, *Agnes Chase* 11155 (GH).

18. **P. glutinosum** Swartz, Prodr. 24 (1788). Perennial, to 1-2 m. tall, decumbent at the base. Leaf-sheaths glabrous with a hispid collar at the apex, the blades to 30 cm. long and 2.5 cm. wide, the margins hispid-ciliate, especially at the base, otherwise glabrous or glabrescent. Panicle open, to 3 dm. long, axis, branches and pedicels glabrous, or the margins finely scabridulous. Spikelets glutinous, subobtuse, to 3-3.5 mm. long. Glumes approximately equal; first glume 2.25 mm. long, broad, 5-nerved, obtuse; second glume about 2.5 mm. long, 7-nerved, obtuse. Sterile lemma 3 mm. long, 5-nerved. Fertile lemma 2.5 mm. long, firm-textured, minutely puberulent at the apex. LA PAZ: LARECAJA: Mapiri, 830 m., *Rusby* 244 (GH); Hacienda Simaco, near Tipuani, 1400 m., *Buchtien* 5316 (GH). SANTA CRUZ: SARA: Monte del Fraile, Buenavista, 450 m., *Steinbach s. n.* (GH).

19. **P. cyanescens** Nees, Agrost. Bras. 220 (1829). Slender perennial, the culms to 6 dm. tall. Leaf-sheaths glabrous, sparsely hispid-pilose at the apex, the linear blades mostly less than 10 cm. long, 4 mm. wide, glabrous above and beneath. Panicle diffuse, less than 10 cm. long, axis, branches and pedicels glabrous. Spikelets to 2 mm. long, ovoid, glabrous. Glumes unequal; first glume 1 mm. long, subobtuse, 1-nerved, with 2 obscure lateral nerves; second glume 1.5 mm. long, obtuse, 5-nerved. Sterile lemma slightly over 1 mm. long, obscurely nerved. Fertile lemma 1.5 mm. long, shining, longitudinally striatulate. SANTA CRUZ: SARA: Buenavista, 500 m., *Steinbach* 5175 (GH), 6940 in part (GH).

20. **P. nervosum** Lam. Encycl. 4: 747 (1798). Perennial, the culms 3-6 dm. tall. Leaf-sheaths somewhat hispid-ciliate, otherwise glabrous, the blades to 8-9 cm. long and 1 cm. wide, glabrous above and beneath, acute, cordate-clasping. Panicle diffuse, to 12-15 cm. long, axis,

branches and pedicels glabrous. Spikelets about 1.5 mm. long, glabrous, rather narrowly ovoid, subobtuse. Glumes markedly unequal; first glume 0.5 mm. long, obtuse to subacute, obscurely nerved; second glume 1.5 mm. long, obscurely 7-nerved. Sterile lemma slightly shorter than second glume, or equal to it. Fertile lemma slightly over 1 mm. long, subacute, shining, longitudinally striatulate. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 1213 (GH); CERCADO: bañado de Piray, 450 m., *Steinbach* 1980 (GH).

21. **P. Sellowii** Nees, Agrost. Bras. 153 (1829). Perennial, spreading, the culms to 1 m. tall. Leaf-sheaths ciliate, pubescent to pilose, often glabrate with age, the lance-linear blades to 20 cm. long and 2 cm. wide, pilose above and beneath, or glabrate with age, acute, the base often abruptly rounded and subpetiolate. Panicle very open at maturity, to 15 cm. long, the branches remote and with the relatively few spikelets along the upper half on slender pedicels, axis and branches sparsely pilose below, pedicels and upper branches scabridulous. Spikelets 2-2.5 mm. long, glabrous. Glumes unequal; first glume to 1.5 mm. long, acute, 1-nerved; second glume 2 mm. long, 5-nerved, subacute. Sterile lemma to 2.5 mm. long, obscurely 5-nerved. Fertile lemma about 2 mm. long, shining, transversely rugulose. LA PAZ: LARECAJA: San Carlos, near Mapiri, 850 m., *Buchtien* 53 (GH); Hacienda Simaco, 1400 m., *Buchtien* 5317 (GH); NOR YUNGAS: Bella Vista, *Hitchcock* 22752 (GH); SUR YUNGAS: La Florida, 1840 m., *Hitchcock* 22638 (GH). COCHABAMBA: CHAPARE: Locotal, 1600 m., *Steinbach* 9095 (GH).

22. **P. parvifolium** Lam. Encycl. Tabl. 1: 173 (1791). Straggling perennial, the culms to 3 dm. tall. Leaf-sheaths glabrous, the blades about 2 cm. long and 5 mm. wide, pilose above and beneath, occasionally glabrous, lanceolate, acute, cordate or subcordate at the base. Panicle open, to 5 cm. long, axis, branches and pedicels glabrous. Spikelets about 1.5 mm. long, glabrous, more or less elliptic-ovoid, obtuse. Glumes somewhat unequal; first glume a little over 1 mm. long, 3-nerved; second glume 1.5 mm. long, 5-nerved, subacute. Sterile lemma as long as second glume, 5-nerved, obtuse. Fertile lemma slightly over 1 mm. long, longitudinally striatulate, shining. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 6646 (GH), 6865 (GH), 7011 (GH), 6940 in part (GH).

23. **P. Rudgei** Roem. & Schult. Syst. Veg. 2: 444 (1817). Tufted perennial, the often flexuose culms to 1 m. tall. Leaf-sheaths densely papillate-pilose, blades more or less linear, acute, to 30 cm. long and 8 mm. wide, equaling the inflorescence, puberulent to pubescent above, pubescent to short-pilose beneath. Panicle large, to 3-4 dm. long, the branches erectly spreading, the axis hirsute-hispid below, glabrous above, branches scabridulous on margins, spikelets remote and solitary at ends of branches. Spikelets to 3.5 mm. long, at least the first glume somewhat hispid. Glumes unequal; first glume 2 mm. long,

5-nerved, very acute, hispid on upper portion; second glume 3 mm. long, 5-nerved, mostly glabrous. Sterile lemma 3 mm. long, glabrous, 7-nerved. Fertile lemma to 2.5 mm. long, obtuse, indurate, shining, longitudinally striatulate. LA PAZ: LARECAJA: San Carlos, 950 m., *Buchtien* 32 (GH).

24. **P. hebotes** Trin. in Mém. Acad. St. Pétersb. (ser. 6) Sci. Nat. **1:** 301 (1834). Perennial, the culms to 6.5 dm. tall. Leaf-sheaths papillate-pilose, the lanceolate blades to 15 cm. long and 1.5 cm. wide, pilose above and beneath, acute, basally cordate. Panicle rather diffuse, to 15 cm. long, axis densely pilose, primary branches more sparsely pilose below, glabrous above, branchlets and pedicels glabrous. Spikelets 2 mm. long, acute, glabrous. Glumes unequal; first glume 1 mm. long, acute, 3-nerved, sometimes obscurely so; second glume 2 mm. long, acute, 9-nerved. Sterile lemma slightly longer than the second glume, about 7-nerved. Fertile lemma slightly less than 2 mm. long, subacute. YUNGAS: *Bang* 493 in part (at least as to GH sheet).

25. **P. sciurotis** Trin. Gram. Pan. 228 (1826). Slender perennial, caespitose, culms to 4 dm. tall, rarely to 6 dm. Leaf-sheaths pubescent, blades lanceolate, to 7 cm. long and 1.2 cm. wide, puberulent above and beneath, acute, the base abruptly cordate-clasping. Panicle much-branched, usually less than 10 cm. long, the branching fine, axis and branches pilose below, glabrous above, pedicels glabrous. Spikelets solitary, to 2 mm. long, minutely puberulous to glabrous. Glumes unequal; first glume 1 mm. long, acute, 1-nerved; second glume 1.5 mm. long, subobtuse, 5-nerved. Sterile lemma nearly 2 mm. long, 7-nerved, subobtuse. Fertile lemma 1.5 mm. long, acute, shining, more or less indurate. LA PAZ: SUR YUNGAS: Chulumani, 1600 m., *Hitchcock* 22669 (GH), 22709 (GH).

26. **P. pantrichum** Hack. in Verh. Zool. Bot. Ges. Wien, **1915:** 72 (1915). Spreading perennial, lower nodes rooting, culms 2-3 dm. tall, but usually shorter. Leaf-sheaths somewhat papillate-pilose, blades lanceolate, to 7-8 cm. long and 8 mm. wide, acute, puberulent above and beneath. Mature panicle spreading, to 15 cm. long, axis and branches scabridulous, the long pedicels puberulent to scabridulous. Spikelets 2 mm. long, or a little longer, hirsutulous to nearly glabrous, ovoid, obtuse. Glumes unequal; first glume 1.5 mm. long, 3-nerved; second glume as long as the spikelet, 5-nerved. Sterile lemma as long as the spikelet, 5-nerved. Fertile lemma indurate, smooth, shining, sometimes obscurely striatulate. LA PAZ: LARECAJA: Mapiri, *Buchtien* 1171 (US).

27. **P. cordovense** Fourn. Mex. Pl. **2:** 26 (1886). Perennial, straggling, culms to 20 cm. tall. Leaf-sheaths papillate-pilose, densely ciliate, the blades to 10 cm. long and 1 cm. wide, lanceolate, acute, glabrous. Panicle to 15 cm. long, axis, branches and pedicels glabrous. Spikelets to 3-3.5 mm. long, acute, glabrous. Glumes somewhat un-

equal; first glume about 3 mm. long, 3-nerved; second glume as long as the spikelet, abruptly acute, 7-nerved. Sterile lemma slightly shorter than second glume, 7-nerved, obtuse. Fertile lemma about as long as the sterile, obtuse, rather indurate, shining. LA PAZ: SUR YUNGAS: La Florida, 1840 m., *Hitchcock* 22647 (GH).

28. **P. versicolor** Doell in Mart. Fl. Bras. 2(2): 254 (1877). Perennial, shortly rhizomatous, erect, the culms to 6 dm. tall. Leaf-sheaths hirsute-ciliate, otherwise sparsely pubescent to glabrous, the linear blades to 20 cm. long and 8 mm. wide, pubescent to glabrous or glabrate. Panicle open, to 10-15 cm. long, axis, branches and pedicels glabrous. Spikelets 2.5 to nearly 3 mm. long, glabrous, asymmetric, racemose on remote slender pedicels along the upper portion of branches, appearing solitary at ends of branchlets. Glumes nearly equal; first glume 1 mm. long, subacute to obtuse, obscurely 3-nerved; second glume slightly over 1 mm. long, about 5-nerved. Sterile lemma about 2.5 mm. long, containing a staminate floret, winged, splitting at maturity. Fertile lemma 2 mm. long, dark brown, shining, with a marked dorsal ridge. SANTA CRUZ: SARA: Río Dolores, *Steinbach* 3542 (GH); Buenavista, 450 m., *Steinbach* 6643 (GH), 6656 (GH).

29. **P. paucispicatum** Morong in Ann. N. Y. Acad. 7: 262 (1893). Coarse perennial, to 1 m. high, usually less, the culms pubescent. Leaves oblong to lanceolate, acute, to 6.5 cm. long and 1.5 cm. wide, densely short-pubescent and ciliate, blades flat. Panicle about 10 cm. long, few-branched, axis, branches and pedicels densely puberulent, the pedicels with an apical collar of long stiff hairs subtending the spikelet. Spikelets fusiform, acuminate, hirsutulous, 5.5-7 mm. long. Glumes unequal, hirsutulous; first glume about 3 mm. long, strongly 5-nerved; second glume as long as the spikelet, strongly 7-nerved. Sterile lemma 5-7 mm. long, hirsutulous above, sparsely so below, about 5-nerved. Fertile lemma indurate, rugose, abruptly acute and subrostrate. SANTA CRUZ: CERCADO: Palmar, *Herzog* 1524 (US).

30. **P. megiston** Schult. Mant. 2: 248 (1824). Stout perennial, creeping at the base, the culms to 1-2 m. tall. Leaf-sheaths sparsely papillate-pilose, the blades lanceolate, to 40 cm. long and 3 cm. wide, long-acute, glabrous above and beneath. Panicle to 6 dm. long, spreading, the primary branches in distant verticils (usually opposite or alternate at the uppermost node), axis hispid at the nodes, otherwise glabrous, branches and pedicels scabridulous on the margins. Spikelets glabrous, to 4 mm. long, broadly ovoid, abruptly acute, usually solitary or in groups of 2 along the branches. Glumes very unequal; first glume about 1.5 mm. long, abruptly subacute, strongly 3-nerved, broader than long and basally completely clasping; second glume about 3.5 mm. long, abruptly acute, 9-11-nerved. Sterile lemma about 3 mm. long, subobtuse, 7-nerved. Fertile lemma about 3 mm. long, abruptly acute, indurate, shining. LA PAZ: CAUPOLICÁN: Ixiamas, *White* (M. E.) 1135 (Hitchcock).

31. **P. olyroides** HBK. Nov. Gen. & Sp. 1: 102 (1816). Erect perennial, the culms to 10 dm. tall. Leaf-sheaths markedly imbricate, glabrous, the linear firm blades to 30 cm. long and 8 mm. wide, glabrous above and beneath. Panicle open, to 3 dm. long, the axis, branches and pedicels densely scabrid-ciliate, the few spikelets on long slender pedicels near the branch-ends. Spikelets 6-8 mm. long, glabrous, fusiform, long-acute. Glumes unequal; first glume to 6 mm. long, long-acute, 5-7-nerved; second glume to 8 mm. long, long-acute, about 9-nerved, with 2 internal basal tufts of subhispid hairs. Sterile lemma to 3.5 mm. long, acute, the nerves prominent near the apex only. Fertile lemma to 3.5 mm. long, obtuse, shining, the base with 2 lateral patches of short, white, crispate hairs. SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 5378 (GH), 6978 (GH).

32. **P. procurrens** Nees ex Trin. Gram. Pan. 183 (1826). Decumbent perennial, spreading, the culms to 6 dm. tall, usually shorter. Leaf-sheaths glabrous with an adaxial apical collar of hairs, blades lance-linear, to 5-6 cm. long and 4-5 mm. wide, acute, white-margined, glabrous to puberulent, often scabridulous beneath. Panicle to 15 cm. long, axis pubescent, the erect branches usually mostly glabrous, the spikelets often somewhat approximate. Spikelets about 3.5-4 mm. long, acute to subacuminate, long-hirsute. Glumes unequal; first glume 2.5 mm. long, strongly 3-nerved, long-acute; second glume 3-3.5 mm. long, 5-nerved, subacute to subobtuse. Sterile lemma as long as second glume, 5-nerved, acute. Fertile lemma shorter than sterile lemma, smooth, shining, chartaceous. SANTA CRUZ: SARA: Dolores, 450 m., *Steinbach* 1801 (GH); Buenavista, 450-500 m., *Steinbach* 5339 (GH), 6940 bis in part (GH), 7012 (GH).

83. **Ichnanthus** Beauv.

Perennials, erect, decumbent or creeping. Leaves pubescent or glabrous. Inflorescence a panicle. Spikelets pedicellate, disarticulating below the glumes, 2-flowered, the lower floret a sterile lemma or staminate, the upper floret perfect. Glumes 2, the lemma shortly stipitate, the stipe with a pair of membranous appendages basally adnate to the base of the fertile lemma, free above, or the appendages wanting and represented by a pair of small pits or scars.

a. Lemma-appendages present.
   b. Lemma-appendages suborbicular, 0.4 mm. long; spikelets 3 mm. long, obtuse. ..... 1. *I. calvescens.*
   b. Lemma-appendages narrowly deltoid, 0.6 mm. long; spikelets to 5 mm. long, acute. ..... 2. *I. peruviana.*

a. Lemma-appendages wanting.
   c. Leaf-sheath auricles well-developed, to 4 mm. long. ..... 3. *I. breviscrobs.*

   c. Leaf-sheath auricles not developed.
      d. First glume shorter than second.

e. Inflorescences terminal and axillary, usually less than 10 cm. long.
f. Spikelets glabrous, or if with a few hairs, these not papillate-based. ..... 4. *I. pallens.*
f. Spikelets sparsely pilose, the hairs papillate-based. ..... 5. *I. candicans.*
e. Inflorescences terminal only, to 20 cm. long. ..... 6. *I. Ruprechtii.*
d. First glume longer than second. ..... 7. *I. minarum.*

1. **Ichnanthus calvescens** (Nees) Doell in Mart. Fl. Bras. 2(2): 285 (1877). Decumbent, the culms to 1 m. tall. Leaf-sheaths pubescent to villous, or glabrous; blades long, lance-elliptic, long-acute, 1-2 cm. wide, densely pubescent above and beneath. Inflorescence to 2 dm. long, narrow, the branches ascending, rachis, branches and pedicels scabridulous, the rachis and branches villous-hispid at the nodes. Spikelets about 3 mm. long, obtuse. First glume about 2.25 mm. long, acute, 3-nerved, the keel scabridulous; second glume about 3 mm. long, 5-nerved. Sterile lemma 3 mm. long. Fertile lemma about 2 mm. long, the appendages suborbicular, 0.4 mm. long. LA PAZ: NOR YUNGAS: Milluguaya, *Buchtien* 737 (Hitchcock); SUR YUNGAS: Chulumani, *Hitchcock* 22653 (Hitchcock).

2. **I. peruviana** Mez in Fedde, Rep. Sp. Nov. 15: 129 (1918). Spreading, to 1 m. tall. Leaf-sheaths pubescent to villous; blades lanceolate, to 10 cm long and 1.5 cm. wide, pubescent above and beneath, or scabridulous above. Panicle to 2 dm. long, open, the few branches short, distant, few-flowered, rachis, branches and pedicels scabridulous on the margins. Spikelets to 5 mm. long, acute. First glume to 5 mm. long, acute, puberulent at the apex, 3-nerved, the keel scabridulous; second glume 4 mm. long, obtuse, puberulous at the apex, 5-nerved, the keel scabridulous above. Sterile lemma about 4 mm. long, obtuse, puberulent, somewhat shortly penicillate, at the apex, rather obscurely 5-nerved. Fertile lemma about 2.5-2.75 mm. long, shining, the apex incurved as a short thick beak, the appendages narrowly deltoid, subobtuse, 0.6 mm. long. LA PAZ: NOR YUNGAS: Coroico, 1560 m., *Hitchcock* 22715 (GH).

3. **I. breviscrobs** Doell in Mart. Fl. Bras. 2(2): 294 (1877). Erect, stout, to 3-5 m. tall. Leaf-sheaths glabrous, with a pair of well-developed auricles to 4 mm. long at the apex; blades long, lanceolate, to 4 cm. wide, scabridulous above and beneath. Panicle open, to 3 dm. long, the branches ascending, rachis, branches and pedicels puberulent. Spikelets 4 mm. long, obtuse. First glume 2.5 mm. long, obtuse, puberulent, 3-nerved, the nerves scabridulous-ciliate; second glume 4 mm. long, obtuse, puberulent, 7-nerved. Sterile lemma 4 mm. long, puberulent above. Fertile lemma 3 mm. long, the apex incurved as a short, thick, blunt beak, appendages wanting, the pits small. LA PAZ: LARECAJA: San Carlos, Mapiri, 750 m., *Buchtien* 60 (GH).

4. **I. pallens** (Swartz) Munro ex Benth. Fl. Hongk. 414 (1861). Creeping, the culms to 3 dm. long. Leaf-sheaths papillate-pilose, auricles not developed; blades ovate to lanceolate, to 10 cm. long, 1-2 cm. wide, asymmetric, glabrous to papillate-pilose above and beneath. Inflorescences terminal and axillary, to 6 cm. long, the branches ascending-spreading, rachis and branches somewhat pilose, the pedicels scabridulous-puberulent. Spikelets to 4 mm. long, acute, glabrous or often with a few long hairs near the nerves and margin, the hairs not papillate-based. First glume 3 mm. long, long-acuminate, 3-nerved; second glume to 4 mm. long, acute, 5-nerved. Sterile lemma 3 mm. long, acute, 5-nerved. Fertile lemma about 2 mm. long, shining, obscurely keeled, the subacute apex only slightly incurved, appendages wanting. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5322 (GH); SUR YUNGAS: Sirupaya, 1650 m., *Buchtien* (in Baenitz) 1401 (GH). COCHABAMBA: CHAPARE: Antahuacana, Espíritu Santo, 750 m., *Buchtien* 153 (GH). SANTA CRUZ: SARA: bosques del Fraile, 450 m., *Steinbach* 2258 (GH).

5. **I. candicans** (Nees) Doell in Mart. Fl. Bras. 2(2): 291 (1877). Creeping plant, much-branched. Leaf-sheaths papillate-villous, the auricles not developed; blades papillate-villous above and beneath, ovate, to 5 cm. long and 1.5 cm. wide. Inflorescences terminal and axillary, to 7-8 cm. long, branches ascending, rachis, branches and pedicels pubescent to scabridulous-puberulent. Spikelets to 4 mm. long, acute, the glumes sparsely papillate-pilose. First glume about 2.5 mm. long, long-acuminate, 3-nerved; second glume about 4 mm. long, shortly acuminate. Sterile lemma about 3 mm. long, obtuse, 5-nerved. Fertile lemma about 2 mm. long, shining, obscurely 3-nerved, very obtuse, the apex not incurved as a beak, appendages wanting. LA PAZ: LARECAJA: San Carlos, Mapiri, 850 m., *Buchtien* 6 (GH).

The line of demarcation between this species and *I. pallens* seems tenuous and rather difficult to draw.

6. **I. Ruprechtii** Doell in Mart. Fl. Bras. 2(2): 293 (1877). Spreading, to 1-2 m. tall. Leaf-sheaths mostly glabrous, auricles not developed; blades lanceolate, to 15 cm. long and 1 cm. wide, glabrous to sparsely pubescent above and beneath. Inflorescences terminal, to 2 dm. long, rachis, branches and pedicels pubescent to pilose, especially at and just below the nodes. Spikelets about 3-4 mm. long. First glume to 3 mm. long, subobtuse, 3-nerved, the keel scabrid-ciliate; second glume 3.5 mm. long, subobtuse. Sterile lemma 3 mm. long, subobtuse. Fertile lemma about 2.5 mm. long, shining, slightly incurved at the subacute apex, appendages wanting. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5336 (GH).

7. **I. minarum** (Nees) Doell in Mart. Fl. Bras. 2(2): 294 (1877). Straggling, sprawling plant. Leaf-sheaths glabrous, auricles not developed; blades lanceolate, to 12 cm. long and 2 cm. wide, glabrous or sparsely pubescent above and beneath, the hairs often papillate-

based. Inflorescence a terminal panicle of a few unbranched racemes, the panicle to 10 cm. long, rachis, branches and pedicels puberulent-scabridulous. Spikelets dense on the raceme-axes, to 4.5 mm. long. First glume 4.5 mm. long, long-acute, scabridulous below, the keel scabridulous, a few long hairs near the apical margins; second glume 3.5 mm. long, similar to the first glume in pilosity. Sterile lemma 3 mm. long, glabrous, 5-nerved, subobtuse. Fertile lemma shining, about 2.5 mm. long, subacute, appendages wanting. LA PAZ: LARECAJA: Cerro del Iminapi, 2650 m., *Mandon* 1256 (GH); SUR YUNGAS: La Florida, 1840 m., *Hitchcock* 22619 (GH).

84. **Lasiacis** (Griseb.) Hitchc.

Perennials, sprawling or clambering, to 10 m., much-branched, woody-stemmed. Leaves flat, rather firm, lanceolate to more or less elliptic, subpetiolate. Inflorescence a rather open panicle; spikelets obliquely placed on the pedicels, 2-flowered, the sterile lemma below the fertile, glumes markedly unequal, lanate at the apex; second glume and sterile lemma similar in appearance; fertile lemma and palea shining, indurate to bony, their apices briefly tufted with short woolly hairs in a slight crateriform depression; disarticulation below the glumes.

Ligule prominent, brown, to 2 mm. long; leaf-blades glabrous above. ..... 1. *L. ligulata.*

Ligule inconspicuous, usually hidden, sometimes to 1 mm. long; leaf-blades pubescent to papillate-hispid above and beneath. ..... 2. *L. sorghoidea.*

1. **Lasiacis ligulata** Hitchc. & Chase in Contrib. U. S. Nat. Herb. 18: 337 (1917). Plants to 5-10 m. long. Leaf-blades narrowly lanceolate, to 12 cm. long, somewhat pubescent to puberulous beneath. Panicle to 10 cm. long, rachis, branches and pedicels puberulent to scabridulous. Spikelets ovoid to obovoid, to 5 mm. long. First glume to 2.5 mm. long, many-nerved; second glume as long as the spikelet, many-nerved, the central nerve more prominent than the others. Sterile lemma as long as second glume, more shining. Fertile lemma slightly shorter than sterile lemma, longitudinally striatulate but not rugose. Glumes and sterile lemma black at maturity. LA PAZ: SUR YUNGAS: Colaya, 1760 m., *Mexia* 4307 (GH). COCHABAMBA: CHAPARE: Locotal, 1600 m., *Steinbach* 9091 (GH); Incachaca, 2400 m., *Steinbach* 9091 (GH).

2. **L. sorghoidea** (Desv.) Hitchc. & Chase in Contrib. U. S. Nat. Herb. 18: 338 (1917). Plants to 5-7 m. long. Leaf-blades lanceolate to somewhat elliptic, to 2.5 cm. long; sheaths sparsely to densely pubescent or villous, blades pubescent to papillate-hispid above and beneath. Panicle to 20 cm. long and nearly as broad at maturity, axis pubescent to sparsely hispid, branches and pedicels puberulent to scabridulous. Spikelets obovoid to subglobose, to 3.5-4 mm. long. First glume 1.5-2

mm. long, not conspicuously nerved, the central nerve prominent; second glume as long as the spikelet, many-nerved. Sterile lemma as long as second glume. Fertile lemma slightly shorter than sterile lemma, obtuse, prominently striatulate. LA PAZ: NOR YUNGAS: Milluguaya, 1300 m., *Buchtien* 157 (GH); SUR YUNGAS: Guanay, 630 m., *Rusby* 191 (GH). COCHABAMBA: CHAPARE: Antahuacana, Espíritu Santo, 750 m., *Buchtien* (in 1909) 161 (GH); CERCADO: Cochabamba, *Bang* 1289 (GH). SANTA CRUZ: SARA: 400-450 m., *Steinbach* 1931 (GH), 5551 (GH), 7111 (GH).

85. **Sacciolepis** Nash

Sacciolepis myuros (Lam.) Chase in Proc. Biol. Soc. Wash. **21:** 7 (1908). Annual, to 1 m. high, in wet or marshy habitats. Leaf-blades flat or folded, long, linear, to 5 mm. wide, usually glabrous, but occasionally sparsely pilose above and beneath. Inflorescence a terminal, racemose, compact, narrow panicle, spicate in appearance, generally 10 cm. or less in length, occasionally to 20 cm., the rachis, branchlets and pedicels more or less densely puberulent. Spikelets about 2 mm. long, pointed, disarticulation below the glumes, 2-flowered, the lower floret a sterile lemma, occasionally a staminate floret, the upper floret perfect. Glumes unequal, the first to 1.5 mm. long, 3-nerved, the second inflated or somewhat saccate, to 2 mm. long, 7-9-nerved, often puberulous near the apex. Sterile lemma as long as the second glume and similar in appearance; fertile lemma shorter than the sterile and concealed by it, hard-textured, shining, sometimes sparsely and minutely puberulent, the margins not inrolled but revealing the hard shining palea, this shorter than but similar to the fertile lemma, the fruit minutely stipitate. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 7030 (GH), 7101 (GH).

86. **Hymenachne** Beauv.

Hymenachne donacifolia (Raddi) Chase in Journ. Wash. Acad. Sci. **13:** 177 (1923). Perennial, to 1 m. high, in wet or swampy habitats. Leaf-sheaths coarsely ciliate, the glabrous blades broadly lanceolate, to 20 cm. long and 3 cm. wide, the bases cordate-clasping or even somewhat auriculate. Inflorescence a terminal, racemose panicle to 3 dm. long, somewhat open, the branches mostly ascending, the rachis, branches and pedicels finely and densely puberulent. Spikelets clustered, acuminate, to 3 mm. long, 2-flowered, the lower floret a sterile lemma, the upper floret perfect; disarticulation below the glumes. Glumes very unequal, the first about 1 mm. long, acute, faintly 3-nerved, the keel ciliolate on the upper portion; second glume to 2 mm. long, acuminate, strongly 3-nerved, neither saccate nor inflated. Sterile lemma about 2.5 mm. long, acuminate, similar to the second glume; fertile lemma shorter than the sterile, without apparent

nerves, smooth, rather shiny, minutely puberulent near the apex, not firm and indurate. Palea as long as the fertile lemma, similar in appearance and texture. SANTA CRUZ: SARA: Curichis, monte de Palometillas, 400 m., *Steinbach* 2150 (GH).

87. **Homolepis** Chase

Homolepis aturensis (HBK). Chase in Proc. Biol. Soc. Wash. **24:** 146 (1911). A decumbent to sprawling perennial, culms to 5 dm. high. Leaf-sheaths densely ciliate and sparsely pilose, the narrowly lanceolate blades flat, to 1.5 cm. wide, often sparsely pilose when young and glabrescent with age, the margins scabridulous. Inflorescence a terminal, racemose, rather narrow panicle to 10 cm. long, the rachis, branches and pedicels glabrous. Spikelets to 7 mm. long. somewhat fusiform, 2-flowered, the upper floret perfect, the lower sterile or sometimes staminate, disarticulation below the glumes. Glumes equal or subequal, to 7 mm. long, the first glume 9-nerved, glabrous; second glume slightly shorter, fewer-nerved, the margins appressed-villous. Sterile lemma shorter than the glumes, enclosing the fertile lemma, densely appressed-villous along the margins; fertile lemma shorter than the sterile, glabrous, shining, firm-textured but not indurate, partially enclosing the similar but shorter palea. SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 1844 (GH), 5120 (GH), 7013 (GH).

88. **Isachne** R. Br.

Isachne arundinacea (Swartz) Griseb. Fl. Brit. W. Ind. 553 (1864). Climbing perennial, the branches up to 6 m. long. Leaf-blades flat, lanceolate, to 20 cm. long and 1.5-2 cm. wide, scabrid above and beneath. Inflorescence a terminal racemose panicle to 12 cm. long, the branches ultimately spreading, the rachis and branches puberulent-scabridulous, the pedicels usually glabrous. Spikelets subglobose, about 2 m. long, disarticulation below the glumes, 2-flowered, the upper floret perfect, the lower floret staminate or perfect. Glumes nearly equal, often suborbicular, about 1.5 mm. long, with a tuft of a few short hairs below the apex. Staminate lemma and palea equal in length, about 2 mm. long, indurate, shining; fertile floret slightly smaller; both lemmas with a few short basal hairs. YUNGAS: *Bang* 297 (GH).

89. **Oplismenus** Beauv.

Oplismenus hirtellus (L.) Beauv. Ess. Agrost. 54, 168 (1812). Spreading, much-branched perennial, the culms 3-5 dm. high. Leaf-sheaths glabrous to densely hirsute, the lanceolate or lance-ovate blades to 10 cm. long, glabrous above, sometimes scabridulous beneath, the margins undulate. Inflorescence a terminal few-branched panicle

of 3-6 short (1-3 cm.) densely flowered racemes, the spikelets paired or solitary, unilateral, very shortly pedicellate, the rachis scabridulous to pubescent or coarsely ciliate. Spikelets 2-flowered, the lower floret a sterile lemma, the upper floret perfect, disarticulation below the glumes. Glumes subequal, about 2.5-3 mm. long, 3-5-nerved, variably pubescent to nearly glabrous, awn of first glume to 6 mm. long, awn of second glume about 2 mm. long. Sterile lemma about 3 mm. long, about 7-nerved, variably pubescent, especially on the nerves, shortly awned or mucronate. Fertile lemma to 2.5 mm. long, indurate, shining, very faintly nerved, the flat margins clasping the palea. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5331 (GH); NOR YUNGAS: Milluguaya, 1300 m., *Buchtien* 738 (GH); Coripata, *Bang* 2079 (GH). SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 1067 (GH), 1859 (GH), 5681 (GH), 1010 (GH); Dolores, 450 m., *Steinbach* 2036 (GH).

90. **Echinochloa** Beauv.

Echinochloa crus-pavonis (HBK.) Schult. Mant. 2: 269 (1824). Annual, erect to decumbent at base, the culms to 1 m. tall. Leaf-sheaths glabrous; blades linear, to 1.2 cm. wide, glabrous, the margins scabridulous. Inflorescence a terminal panicle of racemes, the spikelets solitary or unilaterally clustered on the racemes, the rachis hispid at the nodes, branches and pedicels scabrid. Spikelets about 3 mm. long, plano-convex, 2-flowered, the lower floret sterile or staminate, the upper floret perfect. First glume about 1.5 mm. long, broadly ovate, acute, few-nerved scabrid to hispidulous; second glume 3 mm. long, awned, few-nerved, the nerves strongly short-hispid. Sterile lemma 3 mm. long, few-nerved, the nerves short-hispid, the awn to 4 mm. long. Fertile lemma indurate, about 2.5 mm. long, with a terminal awn or mucro 0.5 mm. long, shining; palea similar but narrower and slightly shorter. LA PAZ: LARECAJA: vic. Sorata, *Mandon* 1258 (GH); Hacienda Simaco, 1400 m., *Buchtien* 5313 (GH); NOR YUNGAS: Coripata, *Bang* 2108 (GH); Polo-Polo, near Coroico, 1100 m., *Buchtien* 445 (GH).

91. **Setaria** Beauv.

See Rominger, J. M. Taxonomy of *Setaria* (Gramineae) in North America. Illinois Biological Monographs, no. 29. 1962.

Annuals or perennials, erect to decumbent and spreading. Leaf-sheaths and blades glabrous to varyingly pubescent. Inflorescence a condensed panicle, the branches seldom obvious, mostly spicate in appearance. Spikelets mostly plano-convex (very obscurely so in 1 species), subtended by 1 to several antrorsely or retrorsely scabrous bristles, 2-flowered, the lower floret a sterile lemma (or occasionally a staminate floret), the upper floret perfect; disarticulation below the

glumes. Glumes unequal; fertile lemma coriaceous to indurate, smooth in 2 species, or rugose or rugulose.

a. Bristles antrorsely scabrous.
  b. Fertile lemma neither rugose nor rugulose.
    c. Leaves plicate; spikelet 3-4 mm. long; bristles 1-2 cm. long. ..... 1. *S. Poiretiana.*
    c. Leaves not plicate, spikelet 2-2.5 mm. long; bristles 5-6 mm. long. ..... 6. *S. oblongata.*
  b. Fertile lemma transversely rugose or rugulose.
    d. Nodes pubescent to villous. ..... 9. *S. barbinodis.*
    d. Nodes glabrous.
      e. Bristles below spikelet 5 or more. ..... 2. *S. geniculata.*
      e. Bristles below spikelet 1, or 2-3 by abortion of spikelets.
        f. Leaf-base rounded, not petiolate nor subpetiolate. ..... 8. *S. argentina.*
        f. Leaf-base gradually tapered, petiolate or subpetiolate.
          g. Main panicle about 10 cm. long; bristles to about 1 cm. long. ..... 10. *S. trichorhachis.*
          g. Main panicle about 20-30 cm. long; bristles to about 2-3 cm. long. ..... 7. *S. vulpiseta.*

a. Bristles retrorsely scabrous, at least on upper half.
  h. Spikelets 2.5-3 mm. long. ..... 3. *S. tenax.*
  h. Spikelets 1.5 mm. long.
    i. Bristles 2-5 mm. long. ..... 4. *S. scandens.*
    i. Bristles 1-1.5 cm. long. ..... 5. *S. tenacissima.*

1. **Setaria Poiretiana** (Schult. in Roem. & Schult.) Kunth, Rév. Gram. 1: 47 (1829). Perennial, the culms to 1-2 m. tall, sometimes villous near the nodes, but the nodes glabrous. Leaf-sheaths papillate-hirsute; leaf-blades plicate, to 5 cm. wide, often pubescent or puberulous below, scabridulcus above and beneath, the base tapering and at least subpetiolate. Panicle to 6 dm. long, the branches ascending, the rachis, branches and pedicels puberulent. Spikelets acute, 3-4 mm. long, secund on the branches, slightly plano-convex, subtended by 1 bristle 1-2 cm. long. First glume 1.5 mm. long, obtuse, 3-nerved; second glume about 2 mm. long, obtuse, 5-nerved. Sterile lemma as long as the spikelet, acute, 2-nerved. Fertile lemma slightly shorter than the sterile, acute to somewhat acuminate, not rugose but prominently longitudinally striatulate. LA PAZ: LARECAJA: San Carlos, Mapiri, 850 m., *Buchtien* 18 (GH); NOR YUNGAS: Coroico, 1560 m., *Hitchcock* 22719 (GH). COCHABAMBA: CHAPARE: Locotal, 1500 m., *Steinbach* 9019 (GH). SANTA CRUZ: SARA: Cerro del Amboró, 1000 m., *Steinbach* 2998 (GH).

2. **S. geniculata** (Lam.) Beauv. Ess. Agrost. 51, 178 (1812). *S. gracilis*, *S. gracilis* f. *brevispica* and *S. gracilis* f. *penicillata* of the Catalogue. Perennial, to 12 dm. tall, the culms geniculate, nodes glabrous. Leaf-sheaths glabrous; blades glabrous beneath, scabridu-

lous above, to 8 mm. wide. Panicle to 10 cm. long but usually shorter, the branches extremely short, rachis, branches and pedicels densely short-pubescent or hispid. Spikelets 2-2.5 mm. long, strongly plano-convex when mature, subtended by 5 or more bristles, these to 1 cm. long on early-season plants or 2-3 mm. long on late-season plants. First glume about 1 mm. long, obtuse, 3-nerved; second glume about 1.5 mm. long, abruptly acute at apex, about 5-nerved. Sterile lemma as long as the spikelet, about 7-nerved, subacute, enclosing a well-developed palea and often a staminate floret. Fertile lemma as long as the sterile, markedly transversely rugose, the palea-apex free at maturity. YUNGAS: *Bang* 218 (GH), 273 (GH). LA PAZ: LARECAJA: vic. Sorata, *Mandon* 1259 (GH); SUR YUNGAS: La Florida, 1840 m., *Hitchcock* 22634 (GH); Sirupaya, 2200 m., *Buchtien* 7029 (GH). COCHAMBAMBA: CERCADO: Cochabamba, 3300 m., *Shepard* 259 (GH), 2500 m., *Eyerdam* 24666 (GH); Mollemolle, 2800 m., *Steinbach* 4057 (GH). SANTA CRUZ: SARA: Buenavista, 500 m., *Steinbach* 6199 (GH).

3. **S. tenax** (L. Rich.) Desv. Opusc. 78 (1831). Perennial, to 1-2 m. tall, the nodes glabrous. Leaf-sheaths glabrous to puberulent, the margins papillate-ciliate; blades to 2 cm. wide, abruptly rounded at the base but not petiolate, scabridulous to pubescent. Panicle to 3 dm. long, the rachis short-villous, the short branches and pedicels puberulous to scabridulous. Spikelets 2.5-3 mm. long, plano-convex to suborbicular, each subtended by a single bristle 1-2 cm. long, this antrorsely scabrous at the base and retrorsely scabrid above. First glume about 1 mm. long, broadly ovate, subacute, 5-nerved; second glume 1.5-2 mm. long, subobtuse, about 7-nerved. Sterile lemma as long as the spikelet, usually with a well-developed palea. Fertile lemma as long as the sterile, smoothish at the apex, strongly transversely rugose below. LA PAZ: NOR YUNGAS: Coripata, *Hitchcock* 22685 (GH).

4. **S. scandens** Schrad. ex Schult. in Roem. & Schult. Syst. Veg. Mant. 2: 279 (1824). Annual, to 8 dm. tall, the culms geniculate at the base, the nodes glabrous. Leaf-sheaths glabrous, the margins ciliate; blades to 1 cm. wide, abruptly narrowed at the base, scabrous-pubescent above and beneath. Panicle to 10 cm. long, the branches very short, rachis short-pubescent with scattered, long, hispid hairs, branches and pedicels puberulous-scabridulous. Spikelets about 1.5 mm. long, plano-convex, subtended by 1-3 bristles retrorsely barbed on the upper portion, the bristles 2-5 mm. long. First glume about 0.75 mm. long, broadly ovate, subacute, 3-nerved; second glume nearly 1.5 mm. long, 5-nerved, subobtuse. Sterile lemma 5-nerved, as long as the spikelet with a palea half as long. Fertile lemma transversely rugose or rugulose, as long as the sterile lemma. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5330 (GH); NOR YUNGAS: Polo-Polo, near Coroico, 1100 m., *Buchtien* 449 (GH).

5. **S. tenacissima** Schrad. ex Schult. in Roem. & Schult. Syst. Veg.

Mant. **2:** 279 (1824). Annual, to 2 m. tall, nodes glabrous. Leaf-sheaths glabrous below, scabrous above; blades to 1 cm. wide, pubescent and scabrous above and beneath. Panicle to 2 dm. long, the branches short (less than 1 cm.), rachis pubescent to hispid, branches and pedicels pubescent. Spikelets plano-convex, 1.5 mm. long, each subtended by a retrorsely scabrous bristle 1-1.5 cm. long. First glume about 1 mm. long, 3-nerved, subobtuse; second glume nearly 1.5 mm. long, 5-nerved. Sterile lemma 1.5 mm. long, 3-5-nerved. Fertile lemma as long as the sterile or slightly shorter, rugulose on the lower portion. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5329 (GH); NOR YUNGAS: Coroico, 1560 m., *Hitchcock* 22717 (GH).

6. **S. oblongata** (Griseb). Parodi in Physis, **9:** 38 (1928). Perennial, to 1.5 m. tall, nodes glabrous. Leaf-sheaths glabrous below, scabrid above; blades long, to 1 cm. wide, scabrous above and beneath. Panicle to 1 dm. long, the branches very short, rather lax, rachis short-villous, branchlets and pedicels puberulent. Spikelets 2-2.5 mm. long, plano-convex, each subtended by a single antrorsely scabrous bristle 5-6 mm. long. First glume 1.5 mm. long, subobtuse, 5-nerved; second glume about 2 mm. long, 7-nerved. Sterile lemma as long as the spikelet, 5-nerved. Fertile lemma as long as the sterile, smooth, shining. LA PAZ: LARECAJA: vic. Sorata, *Mandon* 1260 (Hitchcock).

7. **S. vulpiseta** (Lam.) Roem. & Schult. Syst. Veg. **2:** 495 (1817). Perennial, culms to 2 m. tall, nodes glabrous. Leaf-sheaths somewhat carinate, glabrous below, scabrous to pubescent above; blades basally petiolate or subpetiolate, to 3 cm. wide, scabrous above and beneath. Panicle to 3 dm. long, the ascending branches to 3-4 (occasionally nearly 5) cm. long, rachis and branches villous, pedicels puberulent. Spikelets to 2.5 mm. long, plano-convex, each subtended by 1-2 antrorsely scabrous bristles 2-3 cm. long. First glume about 1 mm. long, 3-5-nerved; second glume about 2 mm. long, 7-nerved. Sterile lemma as long as the spikelet, 5-nerved, with a well-developed palea. Fertile lemma 2.5 mm. long, smooth near the apex, markedly rugose below. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 1178 (GH); Río Surutú, 400 m., *Steinbach* 6842 (GH).

8. **S. argentina** Herrm. in Beitr. Biol. Pflanz. **10:** 54 (1910). Perennial, to 10 dm. tall, the nodes glabrous. Leaf-sheaths glabrous below, sparsely papillate-hirsute above, long-ciliate; blades abruptly rounded at base, to 1 cm. wide, papillate-pubescent above and beneath. Panicle to 12 cm. long, the branches very short, the rachis, branches and pedicels puberulent. Spikelets plano-convex, to 2.5 mm. long, each subtended by 1 antrorsely scabrous bristle (occasionally 2) 8-10 mm. long. First glume nearly 1.5 mm. long, subacute, 3-nerved; second glume about 2 mm. long, acute, 5-nerved. Sterile lemma 2.5 mm. long, acute. Fertile lemma nearly as long as the sterile, smooth above, rugulose below. LA PAZ: MURILLO: Cotaña, 2450 m., *Buchtien* 286 (GH); LARECAJA: vic. Sorata, *Mandon* 1262 (GH). COCHABAMBA:

CERCADO: near Cochabamba, *Hitchcock* 22803 (GH); Valle de Cochabamba, 2700 m., *Steinbach* 9714 (GH).

9. **S. barbinodis** Herrm. in Beitr. Biol. Pflanz. **10:** 60 (1910). Perennial, to 10 dm. high, the nodes pubescent to villous. Leaf-blades linear, long, to 7 mm. wide, scabrid above and beneath, with occasional hairs but hardly pubescent. Panicle to 15 cm. long, interrupted below, the branches short, rachis short-pubescent with few to many long hairs intermixed, the branches and pedicels short-pubescent. Spikelets subglobose, to 3 mm. long, each subtended by 1 antrorsely scabrous bristle to 1 cm. long. First glume about 2 mm. long, acute, 3-nerved; second glume 2.5 mm. long, broad, shortly apiculate, 5-7-nerved. Sterile lemma 3 mm. long, shortly apiculate, 5-nerved. Fertile lemma slightly shorter than the sterile lemma, rugulose to rugose. LA PAZ: LARECAJA: vic. Sorata, *Mandon* 1261 (US; type-number).

10. **S. trichorhachis** (Hack.) R. C. Foster, comb. nov. *S. Liebmannii* f. *trichorhachis* Hack. in Fedde, Rep. Nov. Spec. 8: 46 (1910). Perennial, to 8 dm. tall, the nodes glabrous. Leaf-sheaths glabrous below, sparsely pubescent above, ciliate; blades gradually tapered and subpetiolate at base, to 1.5 cm. wide, scabrous above and beneath. Panicle to 8 cm. long, the branches very short, rachis short-pubescent with numerous longer hairs intermixed, branches and pedicels puberulent. Spikelets plano-convex, 3 mm. long, each subtended by 1 antrorsely scabrous bristle about 1 cm. long. First glume about 1 mm. long, subacute, 5-nerved; second glume 2 mm. long, obtuse, 7-nerved. Sterile lemma about 2.5 mm. long, 5-nerved, acute. Fertile lemma 2.5 mm. long, rugose below, rugulose to smooth above. Without locality: *Bang* 2160 (GH).

92. **Pennisetum** L. Rich.

Perennials, to 5 m. tall. Leaf-blades flat, sparsely pubescent to glabrous and scabridulous, petiolate to subpetiolate. Inflorescence more or less spicate in appearance, the spikelets solitary to few in a fascicle, sessile or subsessile, subtended by a ring of equal to unequal, basally plumose or antrorsely puberulent bristles, 2-flowered, the lower floret a sterile lemma or sometimes a staminate floret, the upper floret perfect; disarticulation below the glumes. Glumes unequal. Fertile lemma chartaceous to herbaceous, mostly smooth.

a. Culm-nodes villous. ..... 4. *P. latifolium.*
a. Nodes glabrous.
b. Bristles plumose.
c. Longest bristles 1.5 cm. long; spikelets 7 mm. long. ..... 1. *P. setosum.*
c. Longest bristles 4 cm. long; spikelets to 1.2 cm. long. ..... 2. *P. villosum.*
b. Bristles not plumose.

d. Longest bristles about as long as the spikelet (4-5 mm.) .... 5. *P. mutilatum*.

d. Longest bristles much longer than the spikelet (about 1.2 cm. long).

e. Second glume 2-3 mm. long; spikelet to 7 mm. long. .... 6. *P. chilense*.

e. Second glume less than 1 mm. long; spikelet to 5 mm. long. ..... 3. *P. tristachyum*.

1. **Pennisetum setosum** (Swartz) L. Rich. in Pers. Synops. Pl. **1:** 72 (1805). Culms 1-2 m. tall, nodes glabrous. Leaf-sheaths glabrous; blades to 4 dm. long and 1.8 cm. wide, pubescent or scabridulous above and beneath. Inflorescence to 25 cm. long, purplish. Spikelets about 4 mm. long. Bristles in 2 series; outer series shorter to slightly longer than the spikelet, antrorsely puberulent; inner series about twice the length of the spikelet (1 bristle much longer than the rest, to 1.5 cm. long), densely silky-plumose basally. First glume about 0.5 mm. long, sometimes absent; second glume 3.5 mm. long, longer than the sterile lemma, acute, puberulous on the upper portion. Sterile lemma about 3 mm. long, obtuse, puberulous, the apex finely ciliolate. Fertile lemma about 2.5 mm. long, the apex penicillate. LA PAZ: NOR YUNGAS: Coripata, *Bang* 2168 (GH).

2. **P. villosum** R. Br. in Fresen. in Mus. Sencken. **2:** 134 (1837). Culms to 0.5 m. tall, nodes glabrous. Leaf-sheaths glabrous; blades 3-5 mm. wide, scabridulous beneath, occasionally sparsely pilose above. Inflorescence to 8 cm. long, sometimes pale-tawny. Spikelets to 1.2 cm. long, 1-4 in a shortly pedunculate fascicle, the peduncle densely short-villous at the base. Bristles to 4 (-5) cm. long, the outer shorter and sparsely or not at all plumose, the inner long and plumose. First glume about 0.5 mm. long; second glume about 3.5 mm. long, long-acute. Sterile lemma about 1 cm. long, long-acute, scabridulous on the nerves above the middle. Fertile lemma 1 mm. shorter than the sterile, acuminate. CHUQUISACA: OROPEZA: outskirts of Sucre, 2700 m., *Cárdenas* 4116 (GH).

3. **P. chilense** (Desv.) Jacks. ex R. E. Fries in Nov. Act. Soc. Sci. Upsal. (ser. 4) **1:** 172 (1905). Culms 1-2 m. tall, from a distinct rhizome, the nodes glabrous. Leaf-sheaths glabrous; blades scabrous beneath, sometimes scabridulous above, to 1 cm. wide. Inflorescence to 2 dm. long, grayish to purplish. Spikelets to 7 mm. long. Bristles of varying lengths, from the length of the spikelet to 1.5 cm. long, antrorsely puberulent, none plumose. First glume nearly 1 mm. long, obtuse; second glume about 2-3 mm. long, subacute, sometimes ciliolate. Sterile lemma 6 mm. long, scabridulous on the upper portion, long-acute. Fertile lemma 6 mm. long, long-acute. LA PAZ: MURILLO: La Paz, 3700 m., *Buchtien* 81 (GH), 161 (GH), *Bang* 55 (GH), *Mandon* 1265 (GH); Palca, 3700 m., *Hitchcock* 22583 (GH). COCHABAMBA: CHAPARE: Sacaba, 2900 m., *Steinbach* 8809 (GH). POTOSÍ: SUR

CHICHAS: Oploca, *Hitchcock* 22898 (GH). TARIJA: CERCADO: Concepción, 1900 m., *Fiebrig* 2595 (GH).

4. **P. latifolium** Spreng. Syst. Veg. **1**: 302 (1825). Culms to 1-3.5 dm. tall, the nodes villous. Leaf-sheaths glabrous to pilose on the upper portion, or papillate-hirsute, the margins hispid-ciliate; blades to 35 cm. long and 5 cm. wide, usually narrower, scabridulous above and beneath. Inflorescence to 10 cm. long, greenish. Spikelets about 4.5 mm. long, acute. Bristles few, not plumose, shorter than or as long as the spikelet, 1 bristle to 1 cm. long. First glume 0.5 mm. long, subacute; second glume about 1 mm. long, ovate, subacute, ciliolate at the apex. Sterile glume as long as the spikelet, acute, scabrid-puberulous. Fertile lemma slightly shorter than the sterile lemma, subacuminate, slightly scabridulous at the apex. LA PAZ: LARECAJA: vic. Sorata; Lucmapampa, Iminapi, 2600 m., *Mandon* 1263 (GH). COCHABAMBA: CERCADO: west of Cochabamba, *Hitchcock* 22847 (GH); CHAPARE: Locotal, 1500 m., *Steinbach* 9014 (GH).

5. **P. mutilatum** (O. Ktze.) Hack. ex Index Kew. Suppl. 2: 137 (1904). *P. sagittatum* Henr. in Blumea, Suppl. 1: 229 (1937). Culms 1-2 m. tall, nodes glabrous. Leaf-sheaths sparsely papillate-hirsute to glabrous; blades glabrous or puberulent at base when young, to 1.5 cm. wide. Inflorescence to 10 cm. long. Spikelets about 4 mm. long. Bristles few, short, equaling or slightly exceeding the spikelet, not plumose. First glume between 0.5-1 mm. long, obtuse; second glume 2-3 mm. long, acute, puberulous above. Sterile lemma nearly as long as the spikelet, acute, antrorsely puberulent on entire dorsal surface. Fertile lemma to 4 mm. long, occasionally scabridulous near the acute apex. LA PAZ: LARECAJA: vic. Sorata; between Munaypata and Challasuyo, 2650 m., *Mandon* 1264 (GH).

6. **P. tristachyum** (HBK.) Spreng. Syst. Veg. **1**: 302 (1825). *P. tristachyum* subsp. *boliviense* Chase in Contrib. U. S. Nat. Herb. **24**: 486 (1927). Culms 2-6 m. tall, branched, nodes glabrous. Leaf-sheaths glabrous; blades to 4 dm. long and 3 or more cm. wide, petiolate, the petioles villous and the blades sparsely villous above and beneath at the base. Inflorescence to 10 cm. long. Spikelets about 5 mm. long, acute. Bristles unequal in length, the longest to 1.5 cm. long, not plumose. First glume about 0.25 mm. long; second glume less than 1 mm. long. Sterile lemma as long as the spikelet, acuminate, scabridulous toward the apex. Fertile lemma slightly shorter than the sterile lemma, acuminate, glabrous or nearly so. LA PAZ: NOR YUNGAS: Coroico, 1100 m., *Buchtien* 451 (GH); Colapampa, *Bang* 2340 (GH). SANTA CRUZ: SARA: Cerro Hosana, 1300 m., *Steinbach* 3379 (GH); Cerro La Negra, 1800 m., *Steinbach* 8172 (GH).

93. Cenchrus L.

Annual or perennial, often to 1 m. tall. Inflorescence a terminal raceme. Spikelets 1-4 in a group, surrounded by an involucre (modi-

fied sterile branchlets) forming spiny burs, the spines usually retrorsely barbed; disarticulation below the burs. Spikelets 2-flowered, the lower floret a sterile lemma, the upper floret perfect. Glumes unequal, the first glume sometimes obsolete.

a. Burs with 1 spikelet; involucral lobes united at the base only. ..... 1. *C. myosuroides.*
a. Burs with more than 1 spikelet; involucral lobes united to about the middle.
  b. Burs with a basal ring of bristles. ..... 4. *C. pauciflorus.*
    c. Involucral lobes interlocking; burs about 4 mm. wide. ..... 2. *C. viridis.*
    c. Involucral lobes not, or seldom, interlocking; burs 5-7 mm. wide. ..... 3. *C. echinatus.*
  b. Burs without a basal ring of bristles. ..... 4. *C. pauciflorus.*

1. **Cenchrus myosuroides** HBK. Nov. Gen. & Sp. **1:** 115 (1816). Perennial, rather woody, to 1.5 m. tall, glaucous, glabrous. Leaf-blades 5-12 mm. wide. Raceme to 25 cm. long, dense; burs 1-flowered, to 5 mm. wide, the lobes united at the base only, free above, the base hispidulous, the outer bristles of the involucre shorter than the inner, both series erect, the inner about equaling the spikelet. Spikelet about 5 mm. long, acute. First glume about 2 mm. long, broadly ovate, acute, 1-nerved; second glume 3.5-4 mm. long, 5-nerved, the midrib prominent. Sterile lemma 4.5 mm. long, similar to second glume. Fertile lemma 5 mm. long, acute; palea almost as long, narrower. COCHABAMBA: TARATA: Anzaldo, 3000 m., *Cárdenas* 2425 (GH); CERCADO: Cochabamba, *Hitchcock* 22806 (GH); Cochabamba Railway Station, 2560 m., *Cárdenas* 2391 (GH); Taquiña, 2700 m., *Steinbach* 9801 (GH).

2. **C. viridis** Spreng. Syst. Veg. 1: 301 (1825). Annual, up to 1 m. tall, glabrous. Leaf-blades to 12 mm. wide. Raceme to 10 cm. long, rather dense; burs usually 3-flowered, subglobose, 4 mm. wide (excluding the bristles), lobes interlocked at maturity, the base pubescent. Spikelet about 7 mm. long, acute. First glume narrowly ovate, 3 mm. long, 1-nerved; second glume 5 mm. long, acute, 5-nerved. Sterile lemma to 6 mm. long, acute, several-nerved. Fertile lemma slightly longer. LA PAZ: SUR YUNGAS: Guanay, *Rusby* (M. E.) 190 (Hitchcock).

3. **C. echinatus** L. Sp. Pl. 1050 (1753). Annual, to 6 dm. high. Leaf-blades to 8 mm. wide, sparsely pilose above near the base. Raceme to 10 cm. long; burs usually 4-flowered, lobes united to the middle, seldom interlocking at maturity, the tips spinose, 5-7 mm. wide (excluding the bristles), pubescent. Spikelet about 7 mm. long. First glume ovate, 2 mm. long, 1-nerved, acute; second glume 4 mm. long, 5-nerved. Sterile lemma 5 mm. long. Fertile lemma 5 mm. long, long-acute. LA PAZ: NOR YUNGAS: Milluguaya, 1300 m., *Buchtien*

4171 (GH). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 6980 bis (GH): Río Surutu, 400 m., Steinbach 5576 (GH), 6838 (GH).

4. **C. pauciflorus** Benth. Bot. Voy. Sulphur, 56 (1840). Annual, often in mats, to 9 dm. tall. Leaf-blades to 7 mm. wide. Raceme to 8 cm. long; burs usually 2-flowered, 4-6 mm. wide, pubescent, the lobes united to the middle. Spikelet about 6 mm. long. First glume about 2 mm. long, acute, 1-nerved; second glume 4 mm. long, 3-nerved. Sterile and fertile lemmas as long as the spikelet, several-nerved. LA PAZ: LARECAJA: vic. Sorata; San Pedro, 2650 m., *Mandon* 1267 (GH).

94. Olyra L.

Perennials, often very tall, often rather woody, plants monoecious. Leaf-blades variable in size, often very large, mostly glabrous, petiolate or subpetiolate. Inflorescence a compact to lax panicle; pistillate spikelets at ends of branches, the staminate spikelets below, these pedicellate, smaller, or the upper branches all with pistillate spikelets and the lower branches all staminate. Pistillate spikelets: rather large, 2-flowered, the lower floret a sterile lemma, the first glume absent, the fruit indurate or bony; disarticulation below the glumes. Staminate spikelets: both glumes and the sterile lemma absent, the fertile lemma and palea membranaceous.

a. Leaf-blades oblong- or triangular-deltoid.
  b. Panicle short, 2-3 cm. long; glume 2-3 mm. long, not caudate; fruit glabrous. ..... 1. *O. lateralis.*
  b. Panicle to 10 cm. long; glume to 2 cm. long, caudate; fruit pubescent. ..... 5. *O. ciliatifolia.*

a. Leaf-blades not deltoid.
  c. Fruit pitted.
    d. Glume to 1 cm. long, densely pubescent externally. ..... 6. *O. micrantha.*
    d. Glume to 3 cm. long; externally glabrous. .... 3. *O. heliconia.*
  c. Fruit not pitted.
    e. Glume 2-4 cm. long, caudate.
      f. Glume about 2 cm. long. ..... 7. *O. latifolia.*
      f. Glume about 4 cm. long. ..... 4. *O. Buchtienii.*
    e. Glume 1 cm. long, not caudate. ..... 2. *O. ecaudata.*

1. **Olyra lateralis** (Presl) Chase in Proc. Biol. Soc. Wash. **21:** 179 (1908). Straggling. Leaf-blades oblong-deltoid, to 4 cm. long and 1.2 cm. wide, the base truncate to subcordate, glaucous beneath, puberulent above when young. Panicle 2-3 cm. long, few-branched, the branches usually whorled. Pistillate spikelet: ovoid, 2-3 mm. long, glabrous; glume with 3 prominent nerves, sterile lemma similar; fruit shining, not pitted, glabrous. Staminate spikelet: linear, acute, 2.5-3 mm. long, puberulent at base. LA PAZ: LARECAJA: San Carlos, Mapiri, 850 m., *Buchtien* 25 (GH); Hacienda Simaco, 1400 m., *Buchtien* 5333 (GH).

2. **O. ecaudata** Doell in Mart. Fl. Bras. **2**(2): 326 (1877). Erect. Leaf-blades oblong, to 20 cm. long and 2.5 cm. wide, scabrid above. Pistillate spikelet: 6-8 mm. long, oblong, acuminate, not caudate. Staminate spikelet: subulate, the lemma cuspidate. PANDO: COBIJA: *Ule* 9146 (Hitchcock).

3. **O. heliconia** Lindm. in Sv. Vet. Akad. Handl. **34**(6): 11 (1900). Stout, little-branched, to 2 m. tall. Leaf-blades oblong, to 35 cm. long and 8 cm. wide, the subtruncate base asymmetric, sparsely puberulent when young. Panicle to 30 cm. long, the few branches in 2-3 distant whorls. Pistillate spikelet: glume to 3 cm. long, long-caudate, sterile lemma to 2 cm. long, long-acute to subcaudate, both puberulent within and glabrous externally; fruit to 1 cm. long, glabrous but conspicuously and regularly pitted. Staminate spikelet: about 1 cm. long, narrowly subulate, often purple. LA PAZ: NOR YUNGAS: Coroico, 1560 m., *Hitchcock* 22720 (GH); Polo-Polo, 1100 m., *Buchtien* 450 (GH). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 2010 (GH).

4. **O. Buchtienii** Hack. in Fedde, Rep. Sp. Nov. **11**: 20 (1912). To 1.5 m. tall. Leaf-blades oblong-lanceolate, to 30 cm. long and 7 cm. wide, the base subtruncate, somewhat asymmetric. Panicle to 15 cm. long, few-branched. Pistillate spikelet: glume and sterile lemma long-caudate, glume to 4 cm. long; glume and lemma puberulent within, scabridulous-puberulent externally; fruit 1 cm. long, glabrous. Staminate spikelet: narrowly ellipsoid, to 4 mm. long, sparsely puberulent. LA PAZ: LARECAJA: San Carlos, Mapiri, 800 m., *Buchtien* 40 (GH).

5. **O. ciliatifolia** Raddi, Agrost. Bras. 19 (1823). Seldom 1 m. tall. Leaf-blades triangular-deltoid, to 10 cm. long and 4 cm. wide, the truncate base asymmetric, glabrous, or pubescent at base when young. Panicle to 10 cm. long, at least the lower branches in whorls. Pistillate spikelet: glume 2 cm. long, very slender-caudate, the sterile lemma similar but shorter, glume and lemma glabrous internally and externally; fruit to 7 mm. long, pubescent. Staminate spikelet: to 7 mm. long, very slender, glabrous. BENI: YACUMA: Lago Rogagua, *Rusby* (M. E.) 1669 (US).

6. **O. micrantha** HBK. Nov. Gen. & Sp. 1: 199 (1816). Very large, to 5 m. tall. Leaf-blades oblong-lanceolate, to 30 cm. long and 10 cm. wide, the base rounded but not cordate, glabrous. Panicle to 30 cm. long. Pistillate spikelet: glume to 1 cm. long, long-caudate, densely pubescent; sterile lemma similar but much shorter; glume and lemma minutely puberulent internally; fruit 3 mm. long, glabrous but regularly and deeply pitted. Staminate spikelet: very narrow, 7 mm. long, the lemma somewhat caudate, glabrous. SANTA CRUZ: ICHILO: Río Vibora, 350 m., *Steinbach* 7572 (GH). LA PAZ: LARECAJA: San Carlos, Mapiri, 750 m., *Buchtien* 76 (GH).

7. **O. latifolia** L. Syst. Nat. (ed. 10) **2**: 1261 (1759). To 5 m. tall.

Leaf-blades lanceolate-oblong, to 30 cm. long and 8 cm. wide, glabrous, acuminate, the base asymmetric. Panicle to 15 cm. long. Pistillate spikelet: glume to 2 cm. long, long-caudate, minutely puberulent externally, hispid-ciliate near the base, internally densely puberulent above the middle; sterile lemma similar but shorter; fruit 5 mm. long, shining, apparently somewhat rugose above the middle, glabrous. Staminate spikelet: slender, to 7 mm. long, the lemma short-caudate. LA PAZ: LARECAJA: Mapiri, *Buchtien* 1155 (Hitchcock).

95. **Imperata** Cyrillo

Caespitose, rhizomatous perennials, the rhizome scaly, the culms unbranched, to 1-2 m. tall. Leaf-sheaths often ciliate, otherwise glabrous; leaf-blades flat or involute, glabrous beneath, pubescent to hirsute above (especially near the base) when young. Inflorescence a panicle of racemes. Spikelets 2-flowered, the lower floret a sterile lemma, the upper floret perfect, pedicellate, awnless; disarticulation below the glumes. Glumes mostly subequal, membranaceous to hyaline, more or less densely villous, the hairs much exceeding the spikelet. Sterile lemma and fertile lemma and palea hyaline, thin.

a. Leaf-blades flat.
   b. Spikelet 4 mm. long. ..... 1. *I. brasiliensis.*
   b. Spikelet 2 mm. long. ..... 3. *I. minutiflora.*

a. Leaf-blades involute (the uppermost sometimes flat). ..... 2. *I. tenuis.*

1. **Imperata brasiliensis** Trin. in Mém. Acad. St. Pétersb. (ser. 6) Math. Phys. Nat. **2:** 331 (1832). To 1 m. tall. Leaf-blades flat, to 1.8 cm. wide, mostly glabrous, the margins scabrid. Panicle about 10 cm. long. Spikelets 4 mm. long, glumes acute, the first glume somewhat shorter than the second. BENI: YACUMA: Reyes, *White* (M. E.) 1535 (Hitchcock).

2. **I. tenuis** Hack. in DC. Monogr. Phan. **6:** 689 (1889). Plants 0.8-2 m. tall. Leaves mostly involute, the uppermost occasionally flat. Panicle to 2 dm. long. Spikelets 4 mm. long, glumes long-acute, the first glume shorter than the second. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 1824 (GH), 6928 (GH); Río Dolores, 450 m., *Steinbach* 1933 (GH).

3. **I. minutiflora** Hack. in DC. Monogr. Phan. **6:** 100 (1889). Plant 0.4-1 m. tall. Leaf-blades to 4 mm. wide. Panicle to 2-3 dm. long. Spikelets 2 mm. long, glumes acute, hairs mostly basal. SANTA CRUZ: SARA: Curichi, 400 m., *Steinbach* 2410 (GH); Río Guendá, 400 m., *Steinbach* 6894 (GH).

96. **Saccharum** L.

Saccharum officinarum L. Sp. Pl. 54 (1753). Very large perennial, to 5 mm.. tall, the culms 2-3 cm. thick. Leaf-sheaths closely imbricate,

the lowermost falling from the culms; blades to 6 cm. wide, midrib very prominent. Inflorescence a plumose panicle to 6 dm. long, the racemes drooping, the rachis disarticulating. Spikelets about 3-4 mm. long, awnless, paired, both with a perfect floret, one sessile, a ring of long hairs at base of each spikelet, 2-flowered. Glumes subequal, acute, subindurate. COCHABAMBA: CHAPARE: Espíritu Santo, *Buchtien* 2514 (Hitchcock).

97. **Eriochrysis** Beauv.

Erect perennials to 1-2 m. tall. Leaf-blades flat to involute, glabrous to sparsely or densely pubescent. Inflorescence a terminal continuous or interrupted panicle of racemes, the raceme-rachis ultimately disarticulating below the spikelets. Spikelets paired, perfect spikelets sessile, pistillate spikelets pedicellate, both long-villous at the base. Glumes subequal, rather indurate; lemma somewhat hyaline; palea hyaline.

Leaf-blades flat, densely velvety-pubescent; panicle dense, almost uninterrupted, deep golden-brown. ..... 1. *E. cayennensis.*
Leaf-blades usually involute, glabrous or sparsely pubescent; panicle obviously interrupted, pale to medium-brown. ..... 2. *E. Warmingiana.*

1. **Eriochrysis cayennensis** Beauv. Ess. Agrost. 8 (1812). Unbranched plant, 1-2 m. tall. Panicle to 12 cm. long, the individual racemes very short. Spikelets about 3 mm. long. First glume obtuse, long-villous on upper portion and along margins; second glume subacute, convex, sparsely long-villous on upper keel. SANTA CRUZ: SARA: Portachuelo, *Steinbach* 1974 (GH); Buenavista, 450-500 m., *Steinbach* 5174 (GH), 6915 (GH).

Occasionally, an intermediate with a more interrupted inflorescence, but almost the typical coloring, will be found, such as *Steinbach* 6975 bis (GH), from Buenavista.

2. **E. Warmingiana** (Hack.) Kuhlm. in Comm. Linhas Telegr. Estrat. Matto Grosso, **67**: 29 (1922). Caespitose, about 1 m. tall, the nodes pubescent. Panicle about 15 cm. long, the racemes 2-4 cm. long. Spikelets to 5 mm. long. First glume long-acute, the upper portion short-puberulent, with a few long hairs, otherwise glabrous; second glume convex, puberulent, with a few long lax hairs on the upper margin. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 1916 (GH), 7032 (GH).

98. **Erianthus** Beauv.

Perennials, 1-3 m. tall, the nodes pubescent to long-villous. Leaf-sheaths sparsely to densely pubescent; leaf-blades flat, pubescent or scabrous. Inflorescence a terminal, rather dense, panicle of racemes. Spikelets perfect, paired, 1 sessile, 1 pedicellate, the pedicel villous

in part, the raceme-rachis disarticulating below the spikelets. Glumes equal or subequal, silky-villous, at least at the base, sterile lemma hyaline, fertile lemma hyaline and long-awned; palea small and hyaline.

Leaf-blades to 1.5 cm. wide; panicle light-colored, 3-4 dm. long. ..... 1. *E. Trinii.*

Leaf-blades less than 1 cm. wide; panicle usually purplish, 1.5-2.5 dm. long. ..... 2. *E. angustifolius.*

1. **Erianthus Trinii** (Hack.) in DC. Monogr. Phan. **6**: 135 (1889). Plants 2-3 m. tall, leaf-blades to 1.5 cm. wide. Panicle to 3-4 dm. long, the base usually enclosed in the inflated upper leaf-sheath, the culms pubescent below the panicle. Spikelets to 7 mm. long (excluding the awn). Glumes acute to slightly bidentate, the upper portion soft-pubescent. Awn of fertile lemma about 1 cm. long, not geniculate. LA PAZ: NOR YUNGAS: Coripata, *Hitchcock* 22682 (Hitchcock).

2. **E. angustifolius** Nees, Agrost. Bras. 316 (1829). Plants about 1 m. tall, leaf-blades 4-8 mm. wide. Panicle 1.5-2.5 dm. long, the base mostly free from the leaf-sheath, culm densely pubescent below panicle. Spikelets to 8 mm. long (excluding the awn). Glumes bidentate, short-pubescent on upper portion. Awn of fertile lemma about 1 cm. long, not geniculate. LA PAZ: NOR YUNGAS: San José, 1500 m., *Hitchcock* 22737 (GH).

99. Andropogon L.

Perennials, to 1-2 m. tall. Inflorescence a panicle of racemes, solitary or 2 or more at apices of branches, the common peduncle usually enclosed by a sheathing spathe. Spikelets 2-flowered, with the lower floret a sterile hyaline lemma, paired on a jointed rachis, 1 spikelet sessile and perfect, the other pedicellate, staminate or neuter, or greatly reduced; disarticulation below the glumes. Glumes of perfect spikelet subequal or somewhat unequal, coriaceous, the first glume bicarinate, the margins inflexed. Fertile lemma hyaline, awned or awnless. Pedicellate spikelet sometimes with the first glumes aristate, sometimes reduced to a pedicel, the pedicels often conspicuously villous.

a. Spikelets awnless.
  b. Rachis-joints clavate, with a cupular hollow at the summit. ..... 2. *A. virgatus.*
  b. Rachis-joints not clavate, the summit without a cupular hollow.
    c. First glume of sessile spikelet glabrous.
      d. Culms 1-2 m. tall; leaf-blades long-attenuate, not boat-shaped at the tip. ..... 9. *A. bicornis.*
      d. Culms 1 m. tall or less; leaf-blades not long-attenuate, boat-shaped at the tip. ..... 11. *A. Selloanus.*
    c. First glume of sessile spikelet not glabrous.
      e. Glume pilose on and near keels. ..... 6. *A. Hassleri.*
      e. Glume merely ciliolate on keels. ..... 10. *A. leucostachyus.*

a. Spikelets awned.
f. Rachis-joints clavate, with a cupular hollow at the summit.
g. First glume of sessile spikelet glabrous.
h. Racemes spreading, rachis flexuose. ..... 1. *A. condensatus.*
h. Racemes appressed, rachis straight.
i. Sessile spikelet 4(-5) mm. long. ..... 4. *A. tener.*
i. Sessile spikelet 5-6 mm. long. ..... 5. *A. cirratus.*
g. First glume of sessile spikelet not glabrous.
j. Sessile spikelet 9-10 mm. long; glume of sterile spikelet long-aristate. ..... 3. *A. hirtiflorus.*
j. Sessile spikelet 5 mm. long; glume of sterile spikelet not aristate. ..... 4. *A. tener hirtiglumis.*
f. Rachis-joints not clavate, not with a cupular hollow at the summit.
k. First glume of sessile spikelet pilose on keels. ..... 7. *A. saccharoides.*
k. First glume of sessile spikelet glabrous.
l. Glume with a dorsal pit. ..... 8. *A. altus.*
l. Glume not pitted.
m. Leaf-blades glabrous.
n. Blades less than 10 mm. wide at base, base not cordate. ..... 12. *A. lateralis.*
n. Blades 15-20 mm. wide at base, base cordate. ..... 13. *A. cordatus.*
m. Leaf-blades pubescent on both surfaces. ..... 14. *A. leptocladus.*

1. **Andropogon condensatus** HBK. Nov. Gen. & Sp. **1:** 188 (1816). Culms to 1 m. or more high. Leaves glabrous, the blades flat, linear, acute to subobtuse. Inflorescence much-branched, corymbose, the rachises flexuose, the rachis-joints clavate, cupular at the apex, unilaterally long-pilose. Sessile spikelets 4.5-5 mm. long, the glumes subequal, the first glume strongly bicarinate, the keels scabrid on upper portion; awn slender, flexuose, to 1 cm. long. Pedicellate spikelets reduced, the pedicels curved and unilaterally long-pilose. YUNGAS: *Bang* 276 (GH). LA PAZ: NOR YUNGAS: Milluguaya, 1300 m., *Buchtien* 38 (GH); Polo-Polo, near Coroico, 1100 m., *Buchtien* 205 (GH); SUR YUNGAS: La Florida, 1840 m., *Hitchcock* 22639 (GH). SANTA CRUZ: SARA: Buenavista, 400-500 m., *Steinbach* 3302 (GH), 5165 (GH), 6809 (GH), 6951 (GH), 6952 (GH), 6953 (GH).

2. **A. virgatus** Desv. ex Hamilt. Prodr. Pl. Ind. Occ. 9 (1825). Culms to 2 m. high. Leaf-blades long, narrowly linear, glabrous above, pubescent beneath (glabrate in old leaves ?). Inflorescence elongate, much-branched, the rachis straight, spikelets densely appressed and ascending, rachis-joints shortly ciliate or ciliolate on the 2 margins, clavate with a cupular apex, racemes 1-2 cm. long, somewhat enclosed in the subtending red-brown or purplish spathes. Sessile spikelets

about 2.5-3 mm. long, the first glume strongly bicarinate, the keels scabrid-ciliolate, otherwise glabrous; lemma awnless. Pedicellate spikelets not reduced, about 2.5 mm. long, the glumes ciliolate on the keels, pedicels puberulent. SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 5344 (GH), 6945 (GH).

3. **A. hirtiflorus** (Nees) Kunth, Rév. Gram. **2:** 569 (1832). *A. Riedelii* of the Catalogue. Culms to 1 m. tall, reddish. Leaves flat, linear, glabrous. Inflorescence much-branched, the rachis straight, racemes and spikelets ascending, rachis-joints pubescent, clavate, with a cupular apex, racemes 6-10 cm. long. Sessile spikelets to 9-10 mm. long, the first glume villous, aristate; lemma awned, the awn twisted, about 1-1.5 cm. long. Pedicellate spikes reduced, aristate, the pedicels pubescent. LA PAZ: LARECAJA: vic. Sorata; between Toquirani and San Pedro, 2700 m., *Mandon* 1385 (GH); between Choquecoa and Mt. Illampu, 3600 m., *Mandon* 1275 (GH); SUR YUNGAS: Chulumani, 1600 m., *Hitchcock* 22658 (GH).

4. **A. tener** (Nees) Kunth, Rév. Gram. **2:** 565 (1832). Densely tufted, the culms to 1 m. tall. Leaf-blades flat or involute, sometimes sparsely long-pilose above. Inflorescence very slender, the rachis straight, rachis-joints clavate, ciliate around the cupular apex and on 1 side, or nearly glabrous. Sessile spikelets 4-5 mm. long, the first glume glabrous or ciliolate on the keels; awn to 1 cm. long. Pedicellate spikelet reduced. shortly aristate. LA PAZ: LARECAJA: Sorata, *Mandon* 1383 (GH); Catarguata, 2700 m., *Mandon* 1381 (GH). TARIJA: ARCE: Camacho, 2500 m., *Fiebrig* 2859 (GH).

4a. **A. tener** subvar. **hirtiglumis** Henr. in Meded. Rijks Herb. Leiden, no. 40: 42 (1921). Resembling *A. tener* in most respects, but with the first glume of the sessile spikelet densely pilose. TARIJA: AVILES: Pinos, 2300 m., *Fiebrig* 3154 (GH; type-number).

5. **A. cirratus** Hack. in Flora, **68:** 119 (1885). Culms to 7 dm. tall, tufted. Leaf-blades flat, linear, scabrid. Inflorescence narrow, the rachis straight, racemes appressed-ascending, rachis-joints unilaterally long-ciliate, clavate, with a cupular apex. Sessile spikelets to 5-6 mm. long, the first glume glabrous; awn to 1 cm. long. Pedicellate spikelets somewhat reduced, the first glume long-aristate, pedicels long-ciliate. TARIJA: CERCADO: Tucumilla, 2200 m., *Fiebrig* 2787 (GH).

6. **A. Hassleri** Hack. in Bull. Herb. Boiss. (ser. 2) 4: 266 (1904). Culms about 1 m. tall, the nodes glabrous. Linear leaf-blades scabridulous beneath. Inflorescence oblong, to 12 cm. long, pale, silky-villous, racemes appressed-ascending, rachis-joints long-silky-villous, especially on the margins. Sessile spikelets about 3 mm. long, pilose, especially on and near the rather rounded keels; awnless. Pedicellate spikelets greatly reduced, the aborted glume short-pubescent near the apex, pedicels densely long-villous. LA PAZ: SUR YUNGAS: Chulumani, 1600 m., *Hitchcock* 22659 (GH).

7. **A. saccharoides** Swartz, Prodr. 26 (1788). Culms tufted, to 1 m. tall, nodes hispid. Leaf-blades glabrous (occasionally some pubescence present), glaucous. Inflorescence to 15 cm. long, exserted, mostly silvery-white, silky-villous, the rachis-joints long-villous. Sessile spikelet about 5 mm. long, the first glume pilose on the keels; awn twisted below, 1(-1.5) cm. long. Pedicellate spikelets somewhat reduced, the pedicels long-villous. LA PAZ: MURILLO: Obrajes, 3400 m., *Buchtien* 574 (GH). COCHABAMBA: CERCADO: Cochabamba, *Hitchcock* 22794 (GH); Quillacolla: Liriuni, 3000 m., *Steinbach* 9847 (GH).

7a. **A. saccharoides** subsp. **laguroides** (DC.) Hack. in DC. Monogr. Phan. **6:** 495 (1889). *A. ternatus* var. *macrothrix* of the Catalogue. Culms shorter, nodes glabrous, and panicle smaller than in *A. saccharoides*. COCHABAMBA: CERCADO: Cochabamba, *Hitchcock* 22823 (Hitchcock).

7b. **A. saccharoides** subsp. **parvispiculus** Hitchc. in Contrib. U. S. Nat. Herb. **24:** 497 (1927). *A. saccharoides* var. *barbinodis* of the Catalogue. Panicle longer, gray or purplish, sessile spikelets 3-4 mm. long. Leaf-blades often pubescent. LA PAZ: LARECAJA: Sorata, 2600-2700 m., *Mandon* 1389 (GH); MURILLO: La Paz, 3300 m., *Bang* 102 (GH); La Paz, 3500 m., *Buchtien* 8846 (GH); SUR YUNGAS: La Florida, 1840 m., *Hitchcock* 22615 (GH). COCHABAMBA: MIZQUE: Vilavila, 2500 m., *Eyerdam* 24975 (GH).

7c. **A. saccharoides** subvar. **perforatus** (Trin.) Hack. in DC. Monogr. Phan. **6:** 496 (1889). First glume of sessile spikelet with a supramedial dorsal pit. Otherwise like *A. saccharoides*. COCHABAMBA: CERCADO: Cochabamba, *Holway* 325 (Hitchcock).

8. **A. altus** Hitchc. in Contrib. U. S. Nat. Herb. **17:** 208 (1913). Culms mostly solitary, the nodes bearded, to 1-2 m. high. Leaf-blades flat, linear, scabrid, with a few long hairs at base of upper surface. Panicle oblong, to 2 dm. long, greenish-white, rachis-joints densely long-villous. Sessile spikelet to 5 mm. long, the glabrous first glume with a supramedial dorsal pit; awn to 2 cm. long. Pedicellate spikelet greatly reduced, the pedicel long-villous. LA PAZ: NOR YUNGAS: Milluguaya, *Buchtien* 4258 (Hitchcock).

9. **A. bicornis** L. Sp. Pl. 1046 (1753). Culms to 1-2 m. tall, the nodes glabrous. Leaf-blades flat, linear, long-attenuate, scabrid. Inflorescence a corymbose, feathery, villous panicle, rachis-joints long-villous. Sessile spikelets about 3 mm. long, the first glume glabrous. Pedicellate spikelets greatly reduced, the pedicels long-villous. LA PAZ: LARECAJA: Hacienda Simaco, 1400 m., *Buchtien* 5312 (GH); NOR YUNGAS: Polo-Polo, near Coroico, 1100 m., *Buchtien* (in 1912) 204 (GH); Milluguaya, 1300 m., *Buchtien* (in 1917) 204 (GH). SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 5274 (GH), 6949 (GH).

10. **A. leucostachyus** HBK. Nov. Gen. & Sp. **1:** 187 (1816). Densely tufted, the culms usually less than 1 m. tall, the nodes glabrous.

Leaf-blades linear, flat, glabrous. Inflorescence a rather short villous panicle, the rachis-joints long-villous. Sessile spikelet awnless, about 3 mm. long, the first glume ciliolate on the keels and sometimes puberulent on the upper portion. Pedicellate spikelets greatly reduced, the pedicels long-villous. LA PAZ: NOR YUNGAS: Milluguaya, 1200 m., *Buchtien* 735 (GH). SANTA CRUZ: SARA: Dolores, 450 m., *Steinbach* 1888 (GH); Buenavista, 450 m., *Steinbach* 6517 (GH), 6845 (GH), 6846 (GH), 6848 (GH).

11. **A. Selloanus** (Hack.) Hack. in Bull. Herb. Boiss. (ser. 2) **4:** 266 (1904). Culms mostly less than 1 m. tall, nodes glabrous. Inflorescence a densely villous panicle, the rachis joints densely long-villous on the upper portion. Sessile spikelets awnless, to 4 mm. long, the first glume glabrous. Pedicellate spikelets greatly reduced, the pedicels densely long-villous. SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 1928 (GH), 5143 (GH), 6515 (GH), 6516 (GH), 6723 (GH), 6874 (GH), 6971 bis (GH).

12. **A. lateralis** Nees, Agrost. Bras. 329 (1829). Culms to 1 m. tall, often purple, the nodes glabrous. Leaf-blades flat, linear, the base not cordate, to 6 mm. wide, glabrous. Inflorescence of 2-4 racemes to 4 cm. long, the rachis-joints long-villous. Sessile spikelet to 4-5 mm. long, the first glume glabrous; awn to 1 cm. long. Pedicellate spikelet not reduced, about 4 mm. long, the pedicel long-villous. SANTA CRUZ: SARA: Río Quimory, 400 m., *Steinbach* 7328 (GH); Buenavista, 450-500 m., *Steinbach* 5427 (GH), 6851 (GH).

13. **A. cordatus** Swallen in Contrib. U. S. Nat. Herb. **29:** 275 (1948). Culms to nearly 2 m. tall. Leaf-blades glabrous, linear-attenuate, the base 15-20 mm. wide and cordate. Inflorescence to 5 dm. long, racemes to 4.5 cm. long, the rachis-joints villous. Sessile spikelet to 4 mm. long, the first glume glabrous; awn to 1.5 cm. long. Pedicellate spikelets to 6.5 mm. long, the pedicel long-villous. COCHABAMBA: TOTORA: Chimoré, 1000 m., *Cárdenas* 2083 (US; type).

14. **A. leptocladus** Hack. in Flora, **68:** 122 (1885). Culms to 4 dm. high, the nodes short-hispid. Leaf-blades bristly-pilose at base, pubescent on both surfaces (at least when young), linear, long-attenuate. Inflorescence exserted, of few racemes, the rachis-joints long-hispid. Sessile spikelet about 6 mm. long, the first glume glabrous or with a few short hairs near the base; awn strongly geniculate, to 4 cm. long. Pedicellate spikelet to 5-6 mm. long, the short pedicel bilaterally ciliate. SANTA CRUZ: SARA: Río Guendá, 400 m., *Steinbach* 7939 (GH).

100. **Hyparrhenia** Anderss.

Hyparrhenia bracteata (Humb. & Bonpl. ex Willd.) Stapf in Prain, Fl. Trop. Afr. **9:** 360 (1918). Perennial, to 1 m. high, or more. Leaf-blades long, linear, narrow (to 4 mm.), appressed-pilose beneath. Inflorescence terminal, to 3 dm. or more, a complex panicle of paired

racemes, these subtended by narrow pilose bracts, 1-2.5 cm. long, the ultimate racemes few-flowered. Spikelets 1-flowered, paired, 1 sessile, fertile, and awned, the other (sometimes 2) pedicellate, the pedicel long-villous, sterile and awnless; disarticulation below the glumes. Fertile spikelet: about 6 mm. long (excluding the awn), the glumes somewhat indurate; first glume with involute margins, bidentate, a few longish hairs near the apex, second glume similar but not bidentate; fertile lemma thin, delicate, shorter than the glumes, the subplumose awn to 2.5 cm. long, loosely twisted. Sterile spikelet: shorter than the fertile, not bidentate, the apices pubescent and subaristate. LA PAZ: SUR YUNGAS: Chulumani, *Hitchcock* 22704 (Hitchcock).

101. **Sorghum** Moench

Sorghum vulgare Pers. Synops. Pl. **1:** 101 (1805). Robust annual, the culms to 1.5 m. high. Leaf-blades long, 2-6 cm. wide, glabrous. Inflorescence a terminal panicle, often condensed, of several few-jointed racemes, these tardily disarticulating. Spikelets paired, the perfect spikelet sessile, the staminate or sterile spikelet pedicellate. Perfect spikelet: glumes subequal, about 5 mm. long, broadly ovate, the first glume few-nerved, more or less shortly silky-villous, the second glume indurate, shining; lemma shorter than the glumes, awned, the awn geniculate, basally twisted, to 1 cm. long, quickly deciduous. Sterile spikelet: pedicel villous, glumes 3-4 mm. long, few-nerved, very sparsely villous. LA PAZ: NOR YUNGAS: Coroico, *Buchtien* 3615 (Hitchcock).

The perennial *S. halepense* (L.) Pers. Synops. Pl. **1:** 101 (1805) may also be found. It has an extensive, creeping, scaly rhizome and, in general, is somewhat more robust than is *S. vulgare*.

102. **Sorghastrum** Nash

Perennials, to 1 m. high, the culm-nodes pubescent to shortly villous, the leaf-sheaths rather prominently auriculate, the blades glabrous to scabrid. Inflorescence a panicle of short racemes, the rachis disarticulating. Spikelets paired, the perfect spikelet sessile or subsessile, the sterile spikelet reduced to a pubescent or villous pedicel. Glumes coriaceous, the fertile lemma hyaline, awned.

a. Awn to 8 cm. long. ..... 1. *S. minarum.*

a. Awn much less than 8 cm. long.

b. Awn less than 1 cm. long, straight or once geniculate, not tightly twisted at base. ..... 2. *S. parviflorum.*

b. Awn to nearly 2 cm. long, twice geniculate, tightly twisted at base. ..... 3. *S. stipoides.*

1. **Sorghastrum minarum** (Nees) Hitchc. in Contrib. U. S. Nat.

Herb. **24:** 501 (1927). Leaf-blades long, mostly flat. Panicles rather dense, somewhat spicate in appearance. Perfect spikelet: glumes equal or subequal, obtuse, to 1 cm. long, the first glume glabrous to sparsely villous on the upper portion, the apex shortly ciliate; second glume glabrous, the apex shortly ciliate. Awn once or twice geniculate, the basal portion tightly twisted, plumosely ciliate, dark brown, the upper portion light brown, straight, shortly scabrid-pubescent. SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 5430 bis (GH), 7028 (GH).

2. **S. parviflorum** (Desv.) Hitchc. & Chase in Contrib. U. S. Nat. Herb. **18:** 287 (1917). Tufted, the leaf-blades flat to involute. Panicle more open, the pedicels and spikelet-bases villous. Perfect spikelet: glumes subequal, 4-5 mm. long, subacute, glabrous or the first glume sparsely villous. Awn glabrous to faintly scabridulous. SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 1819 (GH), 5428 (GH), 6984 (GH), 7050 bis (GH).

3. **S. stipoides** (HBK.) Nash, N. Amer. Fl. **17:** 129 (1912). Slender, leaf-blades narrow, convolute. Perfect spikelet: glumes equal, 5-6 mm. long, subobtuse, the first glume sparsely villous. Awn light brown, the tightly twisted basal portion somewhat plumose-ciliate. LA PAZ: LARECAJA: vic. Sorata, *Mandon* 1382 (Hitchcock). SANTA CRUZ: VALLEGRANDE: Vallegrande, *Herzog* 1789 (Hitchcock).

103. **Heteropogon** Pers.

Perennial or annual. Racemes solitary, digitate, or subdigitate. Staminate spikelets pedicellate, awnless, paired (2-5 pairs) on lowest portion of rachis, this remaining entire. Fertile spikelets sessile, 2-flowered, awned, the lower floret a sterile lemma, each paired with a pedicellate staminate spikelet above the paired staminate spikelets, the rachis disarticulating obliquely, leaving a sharp villous callus below each fertile spikelet.

a. Racemes 2-7, digitately arranged (occasionally solitary on axillary branches); awns to 5 cm. long; pedicels villous. .... 1. *H. villosus.*
a. Racemes solitary; awns 12-15 cm. long; pedicels glabrous.
  b. Glumes all glandless. ..... 2. *H. contortus.*
  b. First glume of staminate spikelets with a dorsal row of punctate glands. ..... 3. *H. melanocarpus.*

1. **Heteropogon villosus** Nees, Agrost. Bras. 362 (1829). *Andropogon villosus* and *Agenium villosum* of the Catalogue. Perennial, erect or spreading, the culms to 1 m. tall, nodes pubescent to villous. Leaf-sheaths pubescent to glabrate, ciliate, the linear acute blades to 10 cm. long and 4 mm. wide, pubescent above and beneath. Inflorescence a terminal panicle of 2-7 digitately or subdigitately arranged racemes on villous peduncles to 1 cm. long, the racemes to 3 cm. long (excluding awns). Staminate spikelets: pedicels villous; first glume to 6 mm. long, acute, hispid to papillate-hispid on upper portion,

many-nerved; second glume somewhat shorter, glabrous, thin-textured, several-nerved; lemma shorter, hyaline, ciliate, the hairs soft and curling. Fertile spikelets: 5 mm. long, excluding awns; first glume 4.5 mm. long, obtuse, villous, only slightly papillate; second glume slightly shorter, acute, sparsely pubescent; lemma about 3 mm. long, thin, terminated by an awn 2.5-5 cm. long, basally twisted, geniculate, ultimately straight, pubescent to apically puberulent. SANTA CRUZ: CERCADO: Santa Cruz, *Herzog* 1308 (Hitchcock).

2. **H. contortus** (L.) Beauv. ex Roem. & Schult. Syst. Veg. **2:** 836 (1817). Perennial, to 8 dm. or 1 m. tall. the culms compressed, nodes glabrous. Leaf-sheaths glabrous, carinate, the linear, acute blades to 15 cm. long and 7 mm. wide, scabridulous above but scarcely so beneath. Inflorescence a terminal, 1-sided raceme about 5 cm. long (excluding awns). Staminate spikelets imbricate, to 1 cm. long, pedicels glabrous; first glume to 1 cm. long, acute, finely short-ciliate, sparsely papillate-hispid above, many-nerved; second glume nearly as long, thin, 1-nerved, glabrous; lemma shorter, hyaline. Fertile spikelets to 7 mm. long; glumes equal, the first brown, densely pubescent, enclosing the second; lemma short, bearing a geniculate, basally twisted awn to 12 (-15) cm. long, the base pubescent to plumose, the apex finely puberulent. LA PAZ: NOR YUNGAS: Coripata, *Hitchcock* 22678 (GH). CHUQUISACA: SUR CINTI: Camataquí, 2500 m., *Fiebrig* 3074 (GH).

3. **H. melanocarpus** (Ell.) Benth. in Journ. Linn. Soc. Bot. **19:** 71 (1882). Annual, to 2 m. tall. Leaf-sheaths glabrous, carinate, the keel with a row of small glands, especially on sheaths of upper leaves, the lance-linear blades to 30 cm. long and 1 cm. wide, scabrid above and beneath. Inflorescences often densely crowded in upper leaves, the racemes to 6 cm. long (excluding the awns); inflorescence to 2-3 dm. long. Staminate spikelets to 1.5-2.5 cm. long, glabrous, the pedicels glabrous; first glume acute, many-nerved, the margins hyaline, with a dorsal line of flat punctate glands in the middle of the glume. Fertile spikelets about 7-10 mm. long; glumes equal, firm, subacute to obtuse, dark brown, pubescent; lemma shorter, thin, bearing a 10-12 cm. geniculate awn, the base twisted, pubescent to subplumose, the upper half straight, puberulent. LA PAZ: NOR YUNGAS: Coripata, *Hitchcock* 22678 (GH).

104. **Trachypogon** Nees

Perennials. Racemes terminal, 1-3 in an inflorescence, the rachis disarticulating. Spikelets paired, the staminate spikelet awnless, sessile or nearly so, persistent; perfect spikelet awned, pedicellate, the pedicel disarticulating, leaving a sharp villous callus below the spikelet.

a. Leaf-blades glabrous to scabrid.
   b. Racemes usually solitary; awn pubescent; glume of staminate spikelet pubescent. ..... 1. *T. montufari.*

b. Racemes 2-3; awn plumose; glume of staminate spikelet glabrous. ..... 2. *T. plumosus.*
a. Leaf-blades villous. ..... 3. *T. canescens.*

1. **Trachypogon montufari** (HBK.) Nees, Agrost. Bras. 342 (1829). *T. polymorphus* var. *bolivianus* Pilger in Engler, Bot. Jahrb. **27**: 22 (1899). Culms to 1 m. tall, the nodes hispid to villous. Leaf-sheaths glabrous, auricles erect, to 1 cm. long, the flat or involute blades to 8 mm. wide, shorter than the inflorescence, glabrous but scabridulous. Inflorescence usually a solitary raceme to 15 cm. long. Staminate spikelet: first glume to 7 mm. long, subacute, dorsally rounded, many-nerved, sparsely pubescent and shortly hispid-ciliate; second glume to 8 mm. long, acute, few-nerved, glabrous or softly and sparsely pubescent along the margins; lemma shorter, hyaline, long-ciliate, the hairs soft. Perfect spikelet: glumes nearly equal, to 7-8 mm. long, few-nerved, firm-textured, pubescent; lemma shorter, hyaline, the geniculate awn to 6 cm. long, densely long-pubescent, the hairs shorter toward the apex. Bolivian Plateau: *Bang* 1079 (GH; type-number of *T. polymorphus* var. *bolivianus*). SANTA CRUZ: SARA: Buenavista, 500 m., *Steinbach* 5379 (GH). TARIJA: ARCE: Camacho, *Fiebrig* 2864 (GH).

2. **T. plumosus** (Humb. & Bonpl. ex Willd.) Nees, Agrost. Bras. 344 (1829). Taller than *T. montufari;* racemes 2-3 (rarely 1); awn plumose; first glume of staminate spikelet glabrous. LA PAZ: LARECAJA: Hacienda Casana, *Buchtien* 7145 (Hitchcock).

3. **T. canescens** Nees, Agrost. Bras. 343 (1829). Very similar to *T. montufari,* but the leaf-sheaths sparsely hispid to papillate-hispid, the involute blades villous. Awn plumose, at least below. LA PAZ: NOR YUNGAS: Puente Villa, 1700 m., *Cárdenas* 3613 (GH). SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 6947 (GH).

105. **Elyonurus** Humb. & Bonpl. ex Willd.

Perennial, up to 1 m. tall, the terminal racemes usually solitary, to 10-15 cm. long, often much shorter, the rachis ultimately disarticulating. Spikelets paired, awnless; staminate spikelet pedicellate; perfect spikelet sessile, appressed against the rachis; spikelet-pairs falling attached to a rachis-joint. Glumes entire or bidentate, slightly glandular on the marginal nerves; lemmas hyaline, thin-textured; palea obsolete.

First glume of staminate spikelet entire. ..... 1. *E. adustus.*
First glume of staminate spikelet bidentate (sometimes only slightly so.) ..... 2. *E. tripsacoides.*

1. **Elyonurus adustus** (Trin.) Ekman in Ark. Bot. **13**(10): 6 (1913). Caespitose, the bases slightly bulbous. Leaf-sheaths glabrous, the linear, flat or inrolled, scabridulous leaf-blades to 4 mm. wide, shorter than the inflorescence. Raceme-rachis and pedicels pubescent to villous. Staminate spikelets: glumes subequal, about 5 mm. long, entire, acute,

the first glume more or less densely hirsute and hispid-ciliate on the submarginal keels, the margins enclosing the second glume, the second glume slightly shorter, pubescent, few-nerved, the upper margin sparsely ciliate with soft curling hairs. Perfect spikelets: glumes subequal, the first glume about 6 mm. long, acute, densely hispid-villous, the second glume slightly shorter, pubescent. LA PAZ: LARECAJA: Hacienda Casana, 1600 m., *Buchtien* 7138 (GH); NOR YUNGAS: Polo-Polo, near Coroico, 1100 m., *Buchtien s. n.* (GH). SANTA CRUZ: SARA: Buenavista, 450-500 m., *Steinbach* 5244 (GH), 5404 (GH), 6620 bis (GH), 6641 (GH), 6642 (GH), 6875 (GH); near Portachuelo, 400 m., *Steinbach* 3136 (GH).

2. **E. tripsacoides** Humb. & Bonpl. ex Willd. Sp. Pl. **4:** 941 (1806). *E. tripsacoides* var. *ciliaris* (HBK.) Hack. in DC. Monogr. Phan. **6:** 333 (1889). *E. tripsacoides* var. *brevidentatus* Hack. in DC. Monogr. Phan. **6:** 334 (1889). Very similar to *E. adustus*, but the bases often more bulbous and shortly rhizomatous. Leaf-blades somewhat pilose above, near the base. First glume of staminate spikelet bidentate, sometimes only shortly so. COCHABAMBA: CERCADO: 5 km. southeast of Cochabamba, 2800 m., *Eyerdam* 24914 (GH); Arani, 2700 m., *Cárdenas* 2382 (GH). SANTA CRUZ: SARA: Buenavista, 400-450 m., *Steinbach* 3270 (GH), 6514 (GH), 6895 (GH), 6896 (GH). TARIJA: ARCE: Camacho, 2500 m., *Fiebrig* 2577 (GH).

Three forms are known in Bolivia. The first glume of the staminate spikelet may be glabrous and strongly ciliate (typical), pubescent (var. *brevidentatus*) or villous (var. *ciliaris*).

The generic name is often spelled *Elionurus*, but I have retained the original spelling, *Elyonurus*.

106. **Manisuris** L.

Perennials, often tall, in moist or wet places. Leaves glabrous, culms glabrous. Inflorescences racemes, these sometimes aggregated in the upper leaf-axils. Spikelets awnless, paired on a disarticulating rachis, the perfect spikelet sessile, appressed against or adnate to the rachis, the sterile spikelet pedicellate or reduced to a pedicel only; glumes firm, coriaceous, lemma and palea hyaline.

First glume of perfect spikelet bidentate, foveolate-pitted on lower half. ..... 2. *M. aurita.*
First glume of perfect spikelet not bidentate, not foveolate-pitted. ..... 1. *M. altissima.*

1. **Manisuris altissima** (Poir.) Hitchc. in Journ. Wash. Acad. Sci. **24:** 292 (1934). *M. fasciculata* (Lam.) Hitch. in Amer. Journ. Bot. **2:** 299 (1915). Culms to 1 m. tall. Leaf-blades flat or folded, to 5 mm. wide; apex of leaf-sheaths densely long-ciliate, base of blades sparsely

short-ciliate. Racemes to 10 cm. long, usually shorter, the rachis rather tardily disarticulating. Perfect spikelet: glumes unequal, first glume 5-7 mm. long, abruptly acute or subobtuse, 9-11-nerved, the nerves rather prominent, the keel narrowly winged on the upper portion, second glume about 1 mm. longer, long-acute, few-nerved, the margins inflolded, with the glume thus somewhat cucullate. Sterile spikelet: glumes short and equal, otherwise resembling the perfect spikelet. LA PAZ: SUR YUNGAS: Espía, *White* (M. E.) 627 (Hitchcock).

2. **M. aurita** (Steud.) Hitchc & Chase in Contrib. U. S. Nat. Herb. 18: 276 (1917). Culms to 1-1.5 m. tall. Leaf-blades flat or folded, to 8 mm. wide, usually narrower, glabrous. Racemes to 10 cm. long, usually less, the base often partially enclosed by a leaf-sheath, the rachis quickly disarticulating. Perfect spikelet: glumes unequal, the first glume 3-4 mm. long, wing-margined above, bidentate, the teeth broad and overlapping, usually foveolate-pitted on the lower half (some glumes occasionally not pitted), nerves not conspicuous, second glume much shorter, the keel winged or at least pronounced, other nerves absent or inconspicuous. SANTA CRUZ: SARA: Buenavista, 450 m., *Steinbach* 6973 bis (GH).

107. **Hackelochloa** O. Ktze.

Hackelochloa granularis (L.) O. Ktze. Rev. Gen. 2: 776 (1891). A much-branched annual, 3-10 dm. high, coarsely hirsute on leaf-sheaths and blades, the sheaths papillate, the blades ciliate. Inflorescences axillary and terminal racemes (often fascicled) to 2.5 cm. long. Spikelets paired, the lower sessile and perfect, clasping the pedicel of the upper, this sterile or staminate; disarticulation in the rachis. Fertile spikelet: first glume about 1 mm. long, globose and globosely pitted or alveolate, finely and minutely puberulent, indurate, concealing the second glume and lemma. Sterile spikelet: glumes equal, about 2 mm. long, broadly lanceolate, several-nerved, not indurate, bicarinate, the keels ciliolate, the margins of the first glume partially enclosing the second glume. SANTA CRUZ: SARA: Monte de Palometillas, 400 m., *Steinbach* 2363 (GH); Buenavista, 800 m., *Steinbach* 5301 (GH). LA PAZ: LARECAJA: vic. Sorata, *Bang* 1310 in part (GH); NOR YUNGAS: Milluguaya, 1300 m., *Buchtien* 4189 (GH).

108. **Tripsacum** L.

Tripsacum australe Cutler & Anderson in Ann. Missouri Bot. Gard. 28: 259 (1941). *T. dactyloides* of the Catalogue. Tall perennial, the culms to 2 m. high. Leaf-sheaths pilose at the margins and at the auricled apex, tomentose within; leaf-blades long, flat, to 4 cm. wide, subpetiolate at the base. Inflorescence terminal, of 1-4 spikes, staminate spikelets above the pistillate, but on the same rachis. Pistillate

spikelets solitary at the nodes, embedded in the axis, with 1 fertile floret and 1 sterile lemma; first glume coriaceous, about 5-10 mm. long, the margin ciliate at base, covering the spikelet, the second glume similar but smaller; fertile lemma shorter than the glumes, hyaline. Staminate spikelets paired at the nodes of rachis, both sessile or 1 pedicellate; glumes firm, chartaceous, about as long as the pistillate glumes. LA PAZ: NOR YUNGAS: Coroico, 1560 m., *Hitchcock* 22721 (GH).

109. Coix L.

Coix lachryma-jobi L. Sp. Pl. 972 (1753). Tall perennials (or sometimes annual ?), branched, the culms to 1 m. high. Leaf-blades much exceeding the inflorescences, to 4 cm. wide, lance-ovate, the base cordate-clasping. Inflorescence long-pedunculate, of 2-3 short pistillate spikelets at the base, enclosed in a hard bony involucre to 1 cm. long, only the spikelet-tips exserted; staminate spikelets usually 3, on a slender axis ultimately exserted from the involucre, the whole raceme about 1 cm. long. COCHABAMBA: CHAPARE: Espíritu Santo, *Buchtien* 2521 (Hitchcock).

GRAY HERBARIUM,
HARVARD UNIVERSITY

NATIVE NORTH AMERICAN SPECIES OF LESPEDEZA (LEGUMINOSAE)*

ANDRE F. CLEWELL

The genus *Lespedeza* occurs in eastern North America, eastern Asia, and Australia. The native American species are perennial herbs, mostly occurring in dry, open sites, such as old fields, roadsides, prairies, and savannahs. The Asian species include shrubs and annuals, the latter sometimes being separated into *Kummerowia* Schindl. (Hutchinson 1964). Two annuals, *L. striata* (Thunb.) H. & A. and *L. stipulacea* Maxim., and one herbaceous perennial, *L. cuneata* (Dumont) G. Don, have been introduced widely in eastern North America from Asia as forage for cattle and wildlife, for preventing soil erosion, and for green manure. All three species have become well-established weeds along roadsides and in similar sites. An Asian shrub, *L. bicolor* Turcz., has become much less widely established after its introduction for purposes of wildlife management, and several other Asian introductions either have not escaped or have remained local. None of the Asian species are treated in this paper; Wilbur (1963) has described the common Asian introductions in detail. I have examined

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specimens of about 36 Asian species; more have been described. Van Steenis (1957) pointed out that certain Asian species intergrade and are in need of revision. Hiroyoshi Ohashi (pers. com.) at the University of Tokyo recently began studying the Japanese species.

Until the Asian species are satisfactorily circumscribed, attempts to divide the genus into subgenera or sections will be premature; Isely (1955) has summarized the previous attempts. *Lespedeza* has long been considered a member of the *Hedysareae* which, according to Isely (1955) and authors cited by him, is an arbitrarily defined tribe of polytypic origin. Hutchinson (1964) has redefined the tribes of the *Leguminosae* and has described a new tribe, the *Lespedezae*, to which *Lespedeza* and several other genera belong (but not *Desmodium*).

LITERATURE

Important contributions from the older literature to a taxonomic understanding of the American species include those by Maximowicz (1873) who prepared the first synopsis on a world-wide basis after most of the species had been discovered; Britton (1893) who first revised the North American species; and Schindler (1913) who wrote the only comprehensive world-wide monograph of *Lespedeza*. More recent critical treatments of the North American taxa are by Blake (1924) on selected species, Fassett (1939) on those occurring in Wisconsin, Fernald (1941) the white-flowered species, Gambill (1953) the species from Illinois, Isely (1955), a detailed account of those occurring in the north-central United States, Turner (1959) the Texas species, and Wilbur (1963), accurate, detailed descriptions of the species in North Carolina. Papers concerned with population studies, breeding systems, cytology, ecology, hybridization, and evolution are Clewell (1964b, 1966). Many of the data in those papers and in this one came from a dissertation, Clewell (1963). Many references to other papers on *Lespedeza* are cited in the Botany Subject Index (compiled by the U.S.D.A. Library, 1958) vols. 5: 4467-69 and 7: 7060-62.

AN EVALUATION OF SOME TAXONOMIC CHARACTERS

To characterize and identify species, it is important to distinguish cleistogamously-formed pods from chasmogamous pods. With rare exceptions cleistogamous and chasmogamous flowers occur on separate racemes. In contrast to racemes with chasmogamous flowers, cleistogamous-flowered racemes generally are shorter, are borne farther down the stem, and bear a few more flowers. Hanson (1943) and Hanson & Cope (1955) have described cleistogamous

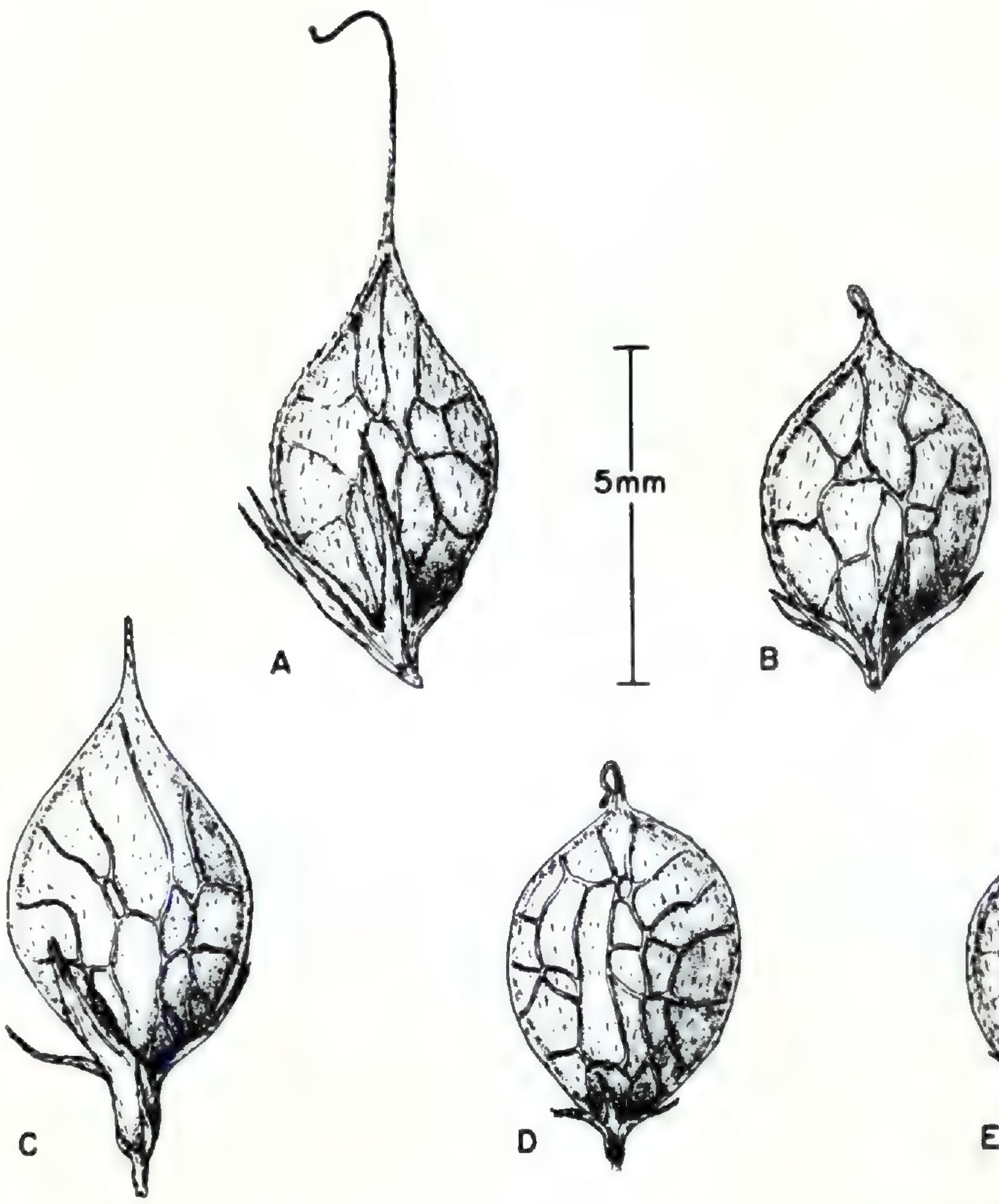


Fig. 1. Chasmogamous and cleistogamous pods. 1a: *Lespedeza intermedia* (chasmogamous); 1b: *L. intermedia* (cleistogamous); 1c: *L. violacea* (chasmogamous, style broken); 1d: *L. violacea* (cleistogamous); 1e: *L. repens* (cleistogamous).

flowers of *Lespedeza* in detail. They pointed out that in bud the style recurves until the stigma rests upon one or more anthers, the filaments of which do not elongate. Pollen grains germinate within the anthers upon which the stigma rests and the tubes grow through the indehiscent anther wall into the stigma (cleistantheric pollination). The style is persistent on mature pods and reflects its mode of development by being sharply recurved. Sometimes an anther adheres to the stigma of a mature pod, evidently held there by the pollen tubes. Styles persistent on chasmogamous pods are longer and either erect or variously curved but not sharply recurved. Cleistogamous pods can be distinguished from chasmogamous ones primarily by the shape of the style and secondarily by the slightly shorter length of the calyxes (Fig. 1). Cleistogamous pods also tend to be shorter and more orbicular, rather than elliptic.

Pollen grains, taken from dried plants and stained with cotton blue in lactophenol, revealed only nominal variation both within and between species. The grains have 3 pores and no ornamentation. Most are 27-33 microns in diameter; however, some plants have slightly larger grains, particularly certain plants of *Lespedeza capitata* and *L. violacea*. Gross pollen morphology is not taxonomically significant.

Chromosome numbers cannot be employed in distinguishing the American taxa, because all plants examined had 10 pairs of chromosomes (Clewell 1966). Pierce (1939) found the chromosomes to be small and rather uniform with no significant variation between species. My own observations confirm his conclusions, thereby negating karyotypic variation as a useful character.

D. A. Levin (pers. com.) has prepared chromatograms from pigments extracted from the leaves of several lespedezas that I sent to him. Included were a specimen of a hybrid and specimens of its parental species and of several other species, including one native to Asia. He concluded that, "the patterns of the different species are quite similar and further study of *Lespedeza* using the present techniques does not appear warranted." Levin discovered a close simi-

larity between some of the chromatograms of the lespedezas and a chromatogram of a plant of *Desmodium ciliare* (Muhl.) DC. This suggests that a comparative chromatographic study of representatives of the *Hedysareae* might be rewarding in assessing relationships between genera.

CONCEPT OF SPECIES

I have observed many populations of *Lespedeza* over a period of 8 years on the Atlantic Coastal Plain and adjacent physiographic provinces from the Carolinas to the Mississippi River, in most of Indiana, and in parts of Texas, Iowa, and the Ozark Plateau. Field observations and analysis led me to my recognition of 11 species. Subsequently progeny tests yielded data supporting my concepts of these species, as did observations on wild plants transplanted and grown in a greenhouse. Each progeny test consisted of removing seeds from one plant, which was collected in a natural population, and planting them under uniform conditions in a garden. The mature offspring were then compared with each other and with their parental plant. With the exception of 6 obvious hybrids, all 378 sibs of the 24 progeny tests clearly resembled their respective parental plants. The species tested were *L. angustifolia, L. capitata, L. hirta* (both subspp.), *L. intermedia, L. procumbens, L. stuevei, L. violacea,* and *L. virginica* (Clewell 1966). Examination of herbarium specimens from throughout the geographic ranges of all species has contributed further to the recognition of each species and has yielded information which has allowed not only the precise delimitation of the species but also the assessment of the geographic variation existing within each species.

Usually a few plants in each population are difficult to identify. Some of these have proved to be shade forms which one can learn to correlate with the variation in the "good" species (see notes on *L. intermedia* in the taxonomic treatment). Other plants appear to be hybrids. Virtually every population of about 50 plants or more consisted of 2-7 species and contained at least one hybrid. Not infrequently

hybrids composed 1% or more of the plants present. The parentage of nearly all hybrids was determined easily in the field, even though several hybrid combinations were present. This was possible because most hybrids appeared to be F_1s, and hybrid swarms with many notomorphs were rare. The parentages of hybrids that have been deposited in herbaria are less easily postulated than of hybrids seen in the field with their parental species. My identifications of *Lespedeza angustifolia* × *hirta* and *L. procumbens* × *stuevei* have gained credence through comparisons with artificially synthesized hybrids of these combinations. The identifications of 24 plants of hybrid origin representing 9 hybrid combinations have been verified through progeny tests yielding a total of 175 mature sibs. These sibs comprised a series of segregants, often with forms characteristic of one parent or the other and including various forms between them (Clewell 1966). My success in having field identification of both hybrids and species verified by progeny tests has convinced me that with a few exceptions hybrids can be distinguished easily from species and that the parentages of hybrids can be postulated accurately. Only one of the 48 plants upon which progeny tests were run proved to be misidentified in the field.

I have used two criteria for circumscribing species: First, plants of any species must be morphologically distinct from plants of other species in a population. Exceptions are shade forms and hybrids. Second, the morphological variation within a species throughout its geographic range has precise limits, and no species seemingly merges into another species in any region. If taxa merge, then they are assigned subspecific status. This species concept applies to *Lespedeza* as it presently occurs and not necessarily to other genera or to *Lespedeza* at other times in its evolutionary history.

In the taxonomic treatment the descriptions of species are prepared so that almost any character of one species can be compared with the same character as it occurs in every other species. Only the more important diagnostic characters are described, thereby emphasizing specific de-

limitation. I have omitted lists of specimens examined. My annotations on the great majority of the specimens I examined serve as documentation of this study. These specimens are deposited in the herbaria listed in the acknowledgements. Mimeographed lists of specimens serving as vouchers for the distribution maps (Figs. 2-13) are available from me on request; a copy will be deposited in the library of Florida State University. No index to exsiccatae was prepared. Identification of duplicate specimens in other herbaria by consulting such an index would be hazardous, because in many instances duplicates under one collection-number represent more than one species and, more commonly, hybrids.

TAXONOMIC TREATMENT*

Lespedeza Michx. Fl. Bor.-Amer. 2: 70 (1803). (Type species: *L. procumbens*).

Hedysarum L. Sp. Pl. 2: 745 (1753). (in part).

Medicago L. Sp. Pl. 2: 778 (1753). (in part).

Lespedezia Hornem. Hort. Reg. Bot. Hafn. 2: 699 (1815).

Perennial herbs from woody rhizomes bearing 1-45 aerial stems, usually branched, and occasionally a short, underground stolon terminating in a new plant; INDUMENT of appressed trichomes (appressed-pubescent, sometimes silvery or sericeous) or soft, erect or spreading trichomes (pilose if short, villous if long and undulating); LEAVES trifoliolate (rarely some with 4-5 leaflets); LEAFLETS entire, nearly equal in shape, often mucro-tipped, the terminal one often slightly longer than the lateral ones; STIPULES inconspicuous, persistent, the longer ones linear or setaceous, the shorter ones subulate; STIPELS minute, usually absent; RACEMES axillary, sometimes spicate or capitate, commonly some or all reduced to axillary fascicles, rarely paniculate; FLOWERS borne in pairs, each pair subtended by 3 bracteoles on the peduncle, each flower pedicellate to nearly sessile and subtended by 2 bracteoles borne near or at the apex of the pedicel opposite the flat surfaces of the pod; CHASMOGAMOUS FLOWERS showy, CALYX campanulate, persistent in fruit, the lobes subequal, the upper 2 being more connate than the others, COROLLA violet, roseate, cream-colored, or white with a purplish spot near the base of the standard; STANDARD suborbicular to oblong, clawed; WINGS falcate-oblong, about equaling the keel; STAMENS diadelphous; ANTHERS uniform; STYLE long, fili-

*Synonyms of *Lespedeza* are limited to those used for native American plants. The generic description also applies only to native American plants.

form, often persistent in fruit; PODS ovate to orbicular, sometimes somewhat asymmetrical, lenticular or laterally compressed, reticulate, mostly indehiscent; CLEISTOGAMOUS FLOWERS often present, sometimes exclusively, about 0.1 the size of chasmogamous flowers, nearly always in separate racemes from chasmogamous flowers, often axillary and averaging a few more flowers per raceme than racemes of chasmogamous flowers; CALYX as in chasmogamous flowers though often slightly shorter; COROLLA greatly reduced; STYLE short, usually persistent in fruit, the distal half sharply recurved and (nearly) touching the proximal half; PODS as in chasmogamous flowers, sometimes tending to be more orbicular and slightly shorter than in chasmogamous flowers; PODS of both chasmogamous and cleistogamous flowers 1-seeded; SEEDS straw-colored to black, sometimes mottled, oval and somewhat laterally compressed.

Ricker (1934) explained that Michaux commemorated the governor of East Florida, 1784-1790, in the name, *Lespedeza*. The governor's name was not D. Lespedez, as stated by Michaux (1803) but Vincente Manuel de Cespedes. Ricker suggested that the change in spelling may have stemmed from an inability of Michaux's son or of L. C. M. Richard to interpret Michaux's notes which were damaged in a shipwreck. The spelling of *Lespedeza* must be retained under Article 73 of the International Code of Botanical Nomenclature (Lanjouw 1961). Through the efforts of Hochreutiner (1934), *Lespedeza* now serves as an illustration for the application of this Article.

I was unable to examine the types of several names applied to the lespedezas, because these types are deposited in European herbaria and were unavailable to me. I have justified the identification of some of these names with certain species in the commentaries on these species. I have associated the remainder of these names with various species both on the basis of the original descriptions and from the comments of Schindler (1913). Schindler examined the type specimens in the European herbaria, and he identified the names in nearly all previous treatments of the genus with the corresponding taxa in his monograph. His lucid discussions made it possible for me to compare my species concepts with his and to gain insight into the concepts of prior authors.

KEY TO NATIVE AMERICAN SPECIES OF LESPEDEZA

1. Stems procumbent to weakly ascending.
   2. Stems procumbent, pilose throughout (uncommonly mostly pilose in *L. texana*). ..... *L. procumbens*
2. Stems appressed-pubescent.
   3. Stems erect up to 1.5 dm, then trailing; the longer stipules 4-8 mm long; leaflets firm-textured, gray-green beneath; plants of central Texas. ..... *L. texana*
   3. Stems procumbent to weakly ascending; the longer stipules 1.5-6 mm long; leaflets membranous, green beneath.
      4. Stems procumbent; keel about equaling wings; calyx of the cleistogamous pods 0.25-0.5 times the length of the pod; stipules mostly subulate, 1.5-4 mm long. ..... *L. repens*
      4. Stems weakly ascending; keel usually longer than wings; calyx of cleistogamous pods up to 0.25 mm long, mostly shorter; stipules mostly filiform, 2.5-6 mm long. .... *L. violacea*
1. Stems erect or strongly ascending.
   5. Calyx nearly equaling or exceeding the mature pod; flowers white with a purple throat (*L. leptostachya* sometimes has light purple flowers); racemes with 10-44 flowers.
      6. The larger terminal leaflets more than half as wide as long. ..... *L. hirta*
      6. The longer terminal leaflets less than half as wide as long.
         7. Rachises longer than their petioles; racemes included within or exserted up to 1.5 times beyond their subtending leaves; calyx mostly 8-13 mm long. ..... *L. capitata*
         7. Rachises of the longer terminal leaflets equaling or generally shorter than their petioles; racemes 1-4 times longer than their subtending leaves; calyx 4-9 mm long.
            8. Leaflets glabrous above and stems appressed-pubescent *or* leaflets pubescent and stems densely pilose; racemes dense, the flowers limited usually to the terminal third of the peduncle; plants of the Atlantic Coastal Plain. .... *L. angustifolia*
            8. Leaflets above and stems appressed-pubescent; racemes open, the flowers scattered on the terminal half of the peduncle; plants of the upper Mississippi Valley. .... *L. leptostachya*
   5. Calyx half as long as the mature pod or shorter; flowers purple; racemes with 4-14 flowers.
      9. Keel often noticeably longer than wings; some racemes usually exserted 2-5 times beyond their subtending leaves; calyx of the cleistogamous pods up to 0.2 (rarely 0.25) times the length of the mature pod; stems sparsely appressed-pubescent;

stipules 2.5-6 mm long. ..... *L. violacea*

9. Keel equaling or shorter than wings; racemes included within or slightly exserted beyond their subtending leaves; calyx of the cleistogamous pods 0.2-0.4 times the length of the mature pod; stems appressed-pubescent or pilose; stipules rarely exceeding 4 mm long.

10. Leaflets glabrous above (rarely appressed-pubescent along the midrib), the longer ones more than 0.3 times as wide as long; stems moderately appressed-pubescent. .... *L. intermedia*

10. Leaflets appressed-pubescent, at least along the midrib, to pilose, the longer ones 0.1-0.5 times as wide as long; stems appressed-pubescent to pilose.

11. Terminal leaflets 0.1-0.3 times as wide as long, sparsely appressed-pubescent above, sometimes only along the midrib. ..... *L. virginica*

11. Terminal leaflets 0.3-0.5 times as wide as long, appressed-pubescent to pilose above. ..... *L. stuevei*

Lespedeza angustifolia (Pursh) Ell. Sketch Bot. S. C. **2:** 206 (1824). (T.: *Clayton 934* [BM]).

Lespedeza capitata var. *angustifolia* Pursh Fl. Amer. Sept. 480 (1814).

Lespedeza hirta var. *angustifolia* Maxim. Acta Horti Petr. **2:** 379 (1873).

Lespedeza angustifolia var. *brevifolia* Britt. Trans. N.Y. Acad. Sci. **12:** 68 (1893). (T.: *A. W. Chapman s. n., Florida* [NY!]).

Lespedeza angustifolia f. *subvelutina* Fern. Rhodora **42:** 457 (1940). (T.: *M. L. Fernald & Bayard Long 9077*, sphagnous bog about 1 mile n. w. of Dahlia, Greenville Co., Va., 20 August 1938 [GH!]).

Lespedeza hirta var. *intercursa* Fern. Rhodora **43:** 572 (1941). (T.: *M. L. Fernald, Ludlow Griscom, & Bayard Long 6622*, argillaceous & siliceous swales & swaley thickets, south of Zuni, Isle of Wight Co., Va., 20, 22 Aug. 1936 [GH!]).

STEMS erect or ascending to about 1.8 m tall, short-appressed-pubescent or sometimes short-pilose; STIPULES filiform to narrowly subulate, 2-4 mm long; PETIOLES short, the terminal leaflets of the larger leaves mostly being at least 2 times longer than the combined lengths of their petiole and rachis and at least 3 times longer on leaves among the racemes; RACHISES of terminal leaflets of the petiolate leaves equaling or shorter than their petioles; TERMINAL LEAFLETS linear or narrowly oblong, the longer ones up to 6 cm long and .07-.25 times as wide, glabrous or occasionally appressed-pubescent above, if appressed-pubescent above, then stems short-pilose; STIPELS often present on some leaves, up to 1 mm long; RACEMES 1-3.5 times longer

than their subtending leaves and mostly bearing 10-26 flowers on the terminal 0.3-0.25 of the peduncle; BRACTEOLES mostly exceeding the base of the lobes of the calyx; PEDICELS 1-2 mm long; FLOWERS 5-7 mm long; CALYX 5-9 mm long, nearly chorisepalous, about equaling to much exceeding the mature pod which is easily visible between the lobes; COROLLA white or cream-colored; WINGS equaling or slightly exceeding the keel; STANDARD equaling or slightly exceeding the wings; PODS oval or elliptic, 3.5-5 mm long, moderately to densely appressed-pubescent; CLEISTOGAMOUS PODS commonly present, generally oval, 3-4 mm long, appressed-pubescent, exceeded by the calyx; SEEDS greenish-yellow to black.

Commonly on moist sand in open pine flatwoods, wet savannahs, along railroad tracks, and in open flood plains; occasionally on drier long leaf pine-scrub oak-wire grass sand ridges, particularly where disturbed; uncommonly on loam soils of pinelands, old fields, and roadsides; from Cape Cod along the Atlantic coast to southeastern Virginia and then both coastal and inland on the Atlantic Coastal Plain to northern Florida; disjunctions in the Georgia Piedmont (Walton Co.), western North Carolina (Henderson Co.), central Tennessee (Coffee, Warren Cos.) central Florida (Hillsborough Co.), and coastal Mississippi (Jackson Co.) (Fig. 2). Flowers from early August through mid-November.

N. K. B. Robson (pers. com.) has examined the holotype and said that it "agrees well" with the key characters.

Whether or not Britton (1893) intended to publish the name, *Lespedeza angustifolia* var. *brevifolia,* is uncertain; his only mention of that name is the following: "I have specimens of a peculiarly short-leaved form of the plant from Florida, communicated by Dr. Chapman, which may claim recognition as var. BREVIFOLIA." The type is a fragment of typical *L. angustifolia*, which Britton received from Chapman in April, 1891.

Most plants of *Lespedeza angustifolia* have leaflets glabrous above and scattered, appressed pubescence on their stems; however, some have both stems and leaflets densely short-pilose. Both types occur sympatrically throughout the range of the species. The latter, pilose type has been recognized as *L. angustifolia* f. *subvelutina*. If this form is

recognized, then it is reasonable that many other forms of equal insignificance in the genus should be named, causing a cumbersome and impractical classification.

Eight specimens annotated as *Lespedeza hirta* var. *intercursa* by Fernald, all of which were collected by Fernald in southeastern Virginia and deposited in GH and US, are typical *L. angustifolia*.

I have searched without success for *Lespedeza angustifolia* from the Choctawhatchee River in western Florida into eastern Louisiana. It occurs sympatrically with *L. capitata* in Florida. The occurrence of *L. capitata* westward near the Gulf coast into eastern Texas is in the same kinds of habitats occupied by both species in Florida while *L. angustifolia* occurs in old fields and roadsides and in frequently burned-over pineland in the Tallahassee Red Hills, an area resembling the Piedmont in soil and physiography. The disjunct populations in central Georgia and western North Carolina might owe their appearance to migrations inland along the flood plains of the major river systems. I hesitate to explain the occurrence of the populations in Tennessee. A. J. Sharp (in verb.) stated that several coastal plain species of other genera occur there. Relatively little morphological variation exists in the species, and no variation is associated with any particular geographic region or habitat.

Closely allied morphologically to *Lespedeza angustifolia* is *L. leptostachya*, an upland prairie endemic of the north-central states. The latter differs from *L. angustifolia* by having a uniformly appressed pubescence on both stems and leaves and densely so on the cleistogamous pods; flowers less densely arranged on the peduncles; narrower calyx lobes subtending the cleistogamous pods; and corolla sometimes light purple.

Lespedeza capitata Michx. Fl. Bor.-Amer. **2:** 71 (1803). (T.: *Michaux* [P]).

Hedysarum umbellulatum Walt. Fl. Car. 184 (1788), non L. 1753.

Hedysarum frutescens Muhl. in Willd. Sp. Pl. **3:** 1193 (1803), non L. 1753.

Hedysarum conglomeratum Poir. in Lam. Encycl. **6:** 416 (1804).
Lespedeza frutescens Ell. Sketch Bot. S. C. **2:** 206 (1824).
Lespedeza stuevei DC. Prodr. **2:** 349 (1825), non Nutt. 1818.
Lespedeza capitata var. *sericea* Hooker Comp. Bot. Mag. **1:** 23 (1835). (T.: *Drummond 227*, Jacksonville, herb. not indicated).
Lespedeza capitata var. *vulgaris* T. & G. Fl. N. Amer. **1:** 368 (1840).
Lespedeza velutina Bickn. Torreya **1:** 102 (1901). (T.: *E. P. Bicknell s. n.*, Woodlawn, N. Y., 28 Aug. 1898 [NY!]).
Lespedeza bicknellii House Torreya **5:** 167 (1905). (T.: *E. P. Bicknell s. n.*, Woodlawn, N. Y., 28 Aug. 1898 [NY!]).
Lespedeza capitata var. *velutina* Fern. Rhodora **10:** 51 (1908).
Lespedeza capitata var. *stenophylla* Bissell & Fern. Rhodora **14:** 92 (1912). (T.: *F. E. McDonald s. n.*, open, dry ground, rare, Peoria, Peoria Co., Ill., Sept., 1904 [GH!]).
Lespedeza capitata var. *typica* Fern. Rhodora **43:** 576 (1941).
Lespedeza capitata var. *stenophylla* f. *argentea* Fern. Rhodora **43:** 579 (1941). (T.: *H. A. Gleason s. n.*, sanddunes, Havana, Mason Co., Ill., Aug. 1903 [GH!]).

STEMS erect or ascending, to about 2 m tall, short appressed-pubescent to long-villous with scattered to dense hairs; STIPULES filiform to narrowly subulate, to about 7 mm long; PETIOLES short, the terminal leaflets of the larger leaves being at least 2 times longer than the combined lengths of their rachises and petioles and 3-9 times longer on leaves among the racemes; RACHISES of terminal leaflets rarely equaling and mostly longer than their petioles; TERMINAL LEAFLETS linear, oblong, narrowly rhombate, or elliptic, the longer ones up to 5 cm long and 0.1-0.45 times as wide, glabrous, glabrate, appressed-pubescent, or sericeous above; STIPELS rarely present; RACEMES capitate, included or exserted by a stout peduncle up to 1.5 times beyond their subtending leaves and generally bearing 14-30 flowers; PEDICELS 1-3 mm long; BRACTEOLES mostly exceeding the base of the lobes of the calyx; FLOWERS mostly 7-9 mm long; CALYX (7-)8-13 mm long, deeply lobed and nearly chorisepalous, the sinuses often very narrow, partially hiding and greatly exceeding the pod; COROLLA white or cream-colored; STANDARD longer than the keel and longer than to nearly equaling the wings; PODS narrowly elliptic, often somewhat asymmetrical, mostly 5-7 mm long; moderately pubescent; CLEISTOGAMOUS PODS common, elliptic, often somewhat asymmetrical, mostly 4-5 mm long, moderately pubescent; SEEDS greenish-yellow to black.

On upland prairies, sand dunes, old fields, dry roadsides, and well-drained, disturbed habitats throughout most of its range; in wet savannahs, open flood plains, and moist ditches along roads and railroads on the Atlantic Coastal Plain and distributed from Maine to northern Minnesota, central Kan-

sas, and the Texas Panhandle south to southeastern Georgia, western Florida, and southeastern Texas. Common in western prairies and in glaciated regions, less common on the Atlantic Coastal Plain, uncommon on the Appalachian Plateau (Fig. 3). Flowers from early July until mid October, mostly in August and September.

The type specimen is mounted on the same sheet with plants of *Lespedeza angustifolia* and intermediates, probably hybrids, between *L. angustifolia* and either *L. capitata* or *L. hirta* (see photograph of this sheet in Fassett, 1939). Fernald (1941) designated the shoot to the extreme right as the holotype of *L. capitata*.

As *Lespedeza capitata* is highly polymorphic, all of the synonyms published since 1835 reflect attempts to delimit various segregates of the species. The indument, the shape of the leaflet, and the length of the peduncle in relationship to the length of the subtending leaf are three of the more conspicuously variable characters. Fassett (1939, p. 102) planted seeds from different varieties of *L. capitata* and obtained offspring which segregated widely in pubescence and leaflet shape from both their parental plants and their sibs. He found that there would be eight morphological races (varieties) of *L. capitata* in Wisconsin by using the same characters of pubescence and leaflet-shape that were used in describing the four varieties recognized by Fernald. Pierce (1939) planted seeds from cleistogamously formed pods from two widely divergent specimens of *L. capitata* and obtained considerable variation among each of their progenies.

Little sense can be made of this variation until several hundred specimens of *Lespedeza capitata* from all parts of its geographic range are amassed for comparisons. After making such comparisons, two conclusions become evident: that populations of *L. capitata* near or above the southern limit of the Wisconsin glaciation are highly polymorphic and populations below this region are relatively uniform; and that certain forms of *L. capitata* are much more char-

acteristic of particular geographic regions than they are of other regions. This geographic variation is as follows:

1. *Lespedeza capitata* with nearly linear leaflets, tapering gradually from the middle to the base and apex, glabrous above, and stems with appressed trichomes (*L. c.* var. *stenophylla* Bissell & Fern.). This form occurs primarily from northeastern Indiana to eastern Iowa, south to southwestern Illinois; however, individuals have been collected in Rhode Island, Virginia and elsewhere.

2. *Lespedeza capitata* with narrowly elliptic or oblong leaflets, sericeous above, and with stems densely pubescent with very short, nearly straight trichomes, giving a silvery or cinnamon-colored appearance. (*L. c.* var. *capitata* sensu Gl.; var. *sericea* Hook., var. *typica* Fern.). This is the most common form and occurs frequently in all parts of the range of the species with the possible exception of the Appalachian Plateau. It is by far the most common type in western Iowa, South Dakota, Nebraska, Kansas, Oklahoma, and along the Atlantic Coastal Plain from North Carolina to Florida and westward to Louisiana. The populations from the Southeast are strikingly uniform. There is a slight tendency for southeastern plants to have oblong leaflets, while midwestern plants of this form have narrowly elliptic leaflets. In Iowa and Illinois many plants have been collected that resemble this form except that they have leaflets glabrous above. I have also observed a few populations in the Southeast with glabrous leaflets. Many plants from Ontario have exceptionally long, appressed trichomes on the leaflets, and these plants are not quite as silvery as others of this form and appear velutinous. These plants from Ontario and others like them, especially from coastal New England, have been named *L. velutina* Bickn. (*L. c.* var. *velutina* (Bickn.) Fern.). Prostrate forms of what might otherwise be called var. *velutina* have been observed by F. C. MacKeever (pers. com.) on Nantucket Island, Massachusetts. Attempts to grow living plants of this prostrate form which were sent to me by MacKeever were unsuccessful. Intergrades between plants that have been called var. *capitata* and var.

stenophylla are named *L. c.* var. *stenophylla* f. *argentea* Fern.

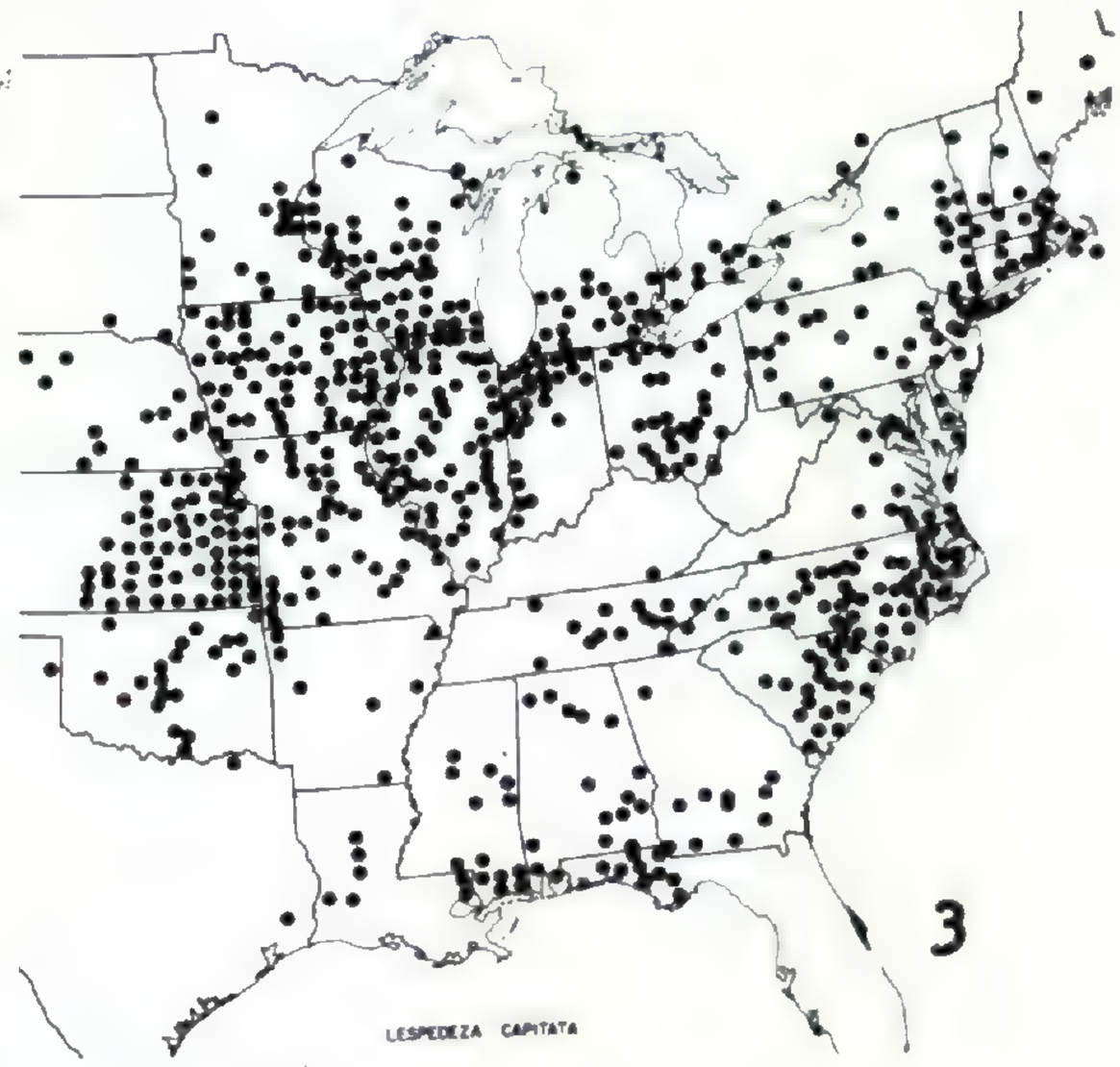
3. *Lespedeza capitata* with (narrowly) elliptic leaflets, glabrous above, stems with variable pubescence, usually (short-)villous (*L. c.* var. *vulgaris* T. & G.). This is the most common form in the Appalachians; however, I have examined only a few specimens from the southern Appalachians, and some of these have been anomalous forms with leaflets glabrous above.

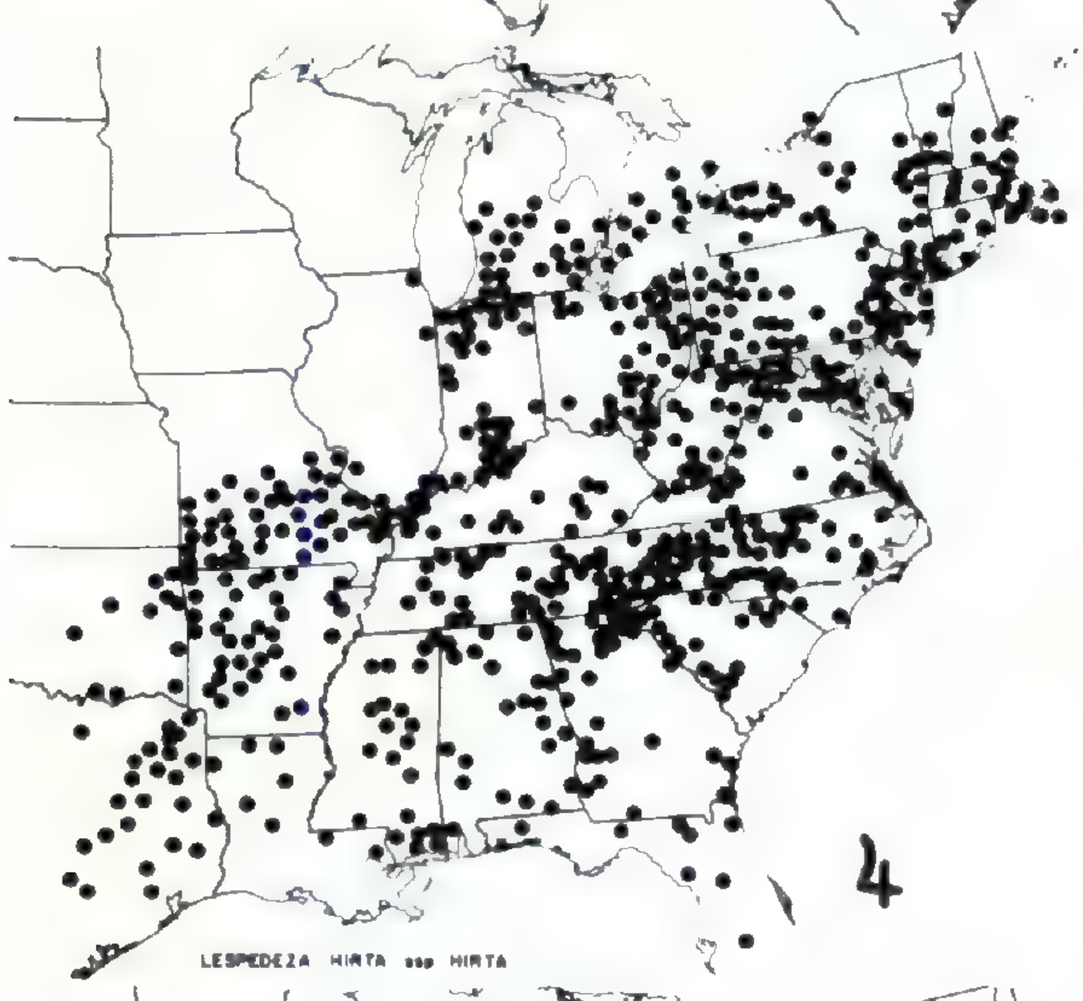
Intergradations between the various forms, the occurrence of many anomalous forms, and the heterogeneity encountered by Fassett (1939) and Pierce (1939) in progeny tests preclude the practicability of naming each form. Delimitation of forms would have to be arbitrary, a "waste basket" taxon would be necessary for anomalous forms, and identification would remain difficult for many plants.

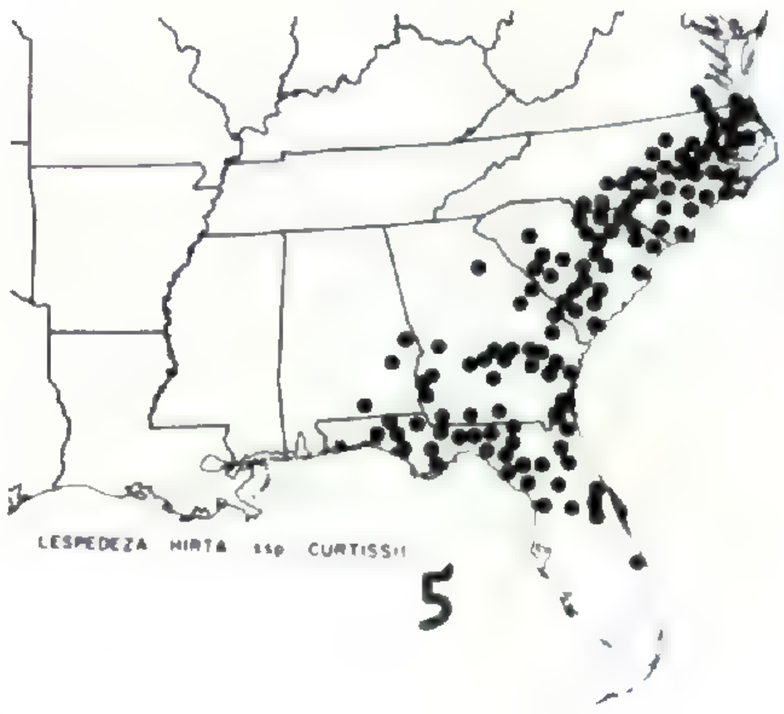
An excellent character separating *L. capitata* from all other American species has been overlooked by previous authors: the distinctly greater length of the rachis as compared to the length of its petiole, especially of the larger leaves.

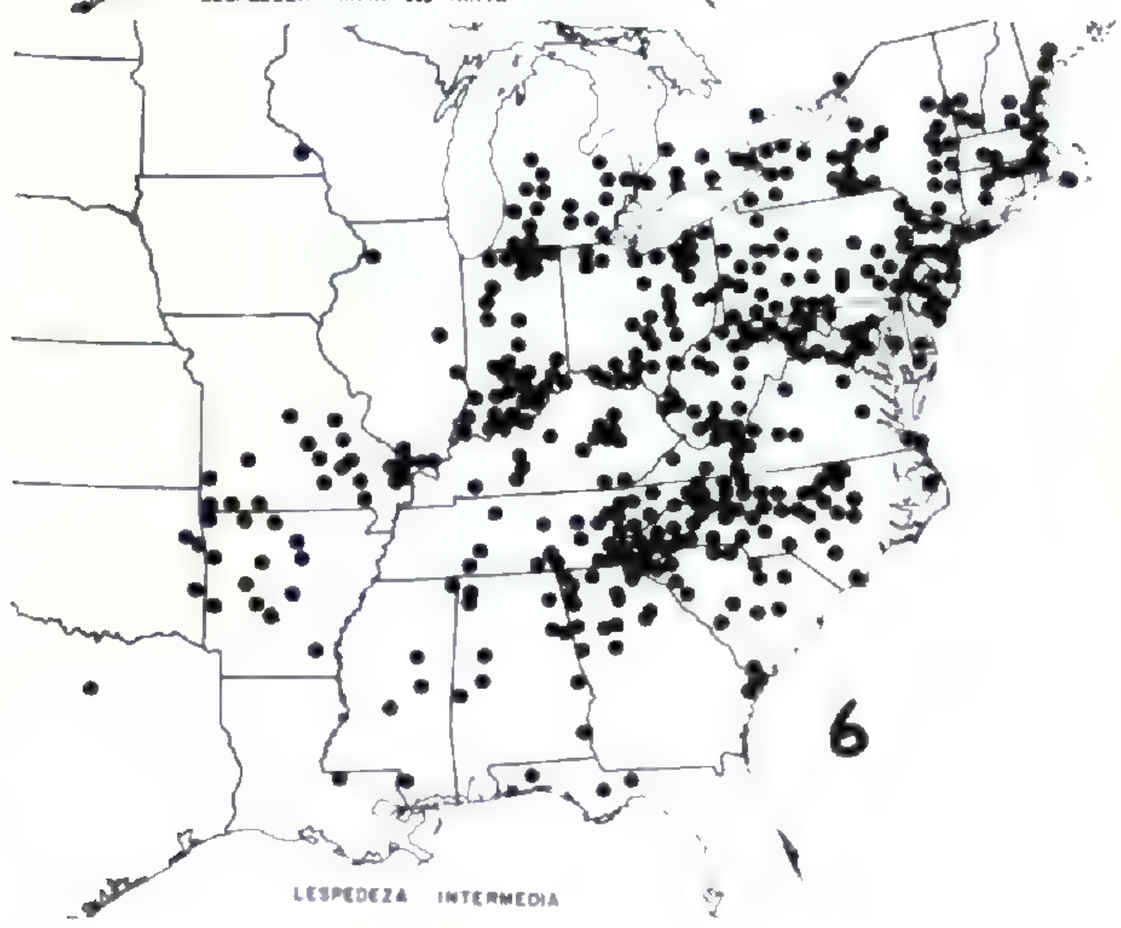
From the distribution of *L. capitata* (Fig. 3) it seems logical that the plants occurring in the northern part of the lower peninsula of Michigan arrived there recently via a post-glacial migration through Wisconsin and the upper peninsula of Michigan, not northward through southern Michigan. Heard (1962) reported a similar migration route for certain sphaeriid clams. Range extensions of *L. capitata* in Michigan in the future will be noteworthy.

Lespedeza hirta (L.) Hornem. Hort. Reg. Bot. Hafn. **2**: 699 (1815). STEMS erect or ascending, to 1.8 m tall, short-appressed-pubescent to long-villous; STIPULES filiform to subulate, 3-6 mm long: PETIOLES long, the terminal leaflets of the longer leaves being 1-2.5 times longer than the combined lengths of the petiole and rachis and mostly 2-4 times longer on leaves among the racemes; RACHISES of the longer terminal leaflets equaling or shorter than their petioles; TERMINAL LEAFLETS elliptic or (ob-)ovate, the longer ones up to 4 cm long and (0.45-)0.5-0.8 times as wide, glabrous, appressed-pubescent, or pilose above; STIPELS rarely present; RACEMES open, mostly 1.5-4 times









Figs. 2-7. Distribution by county of 6 taxa. Fig. 2, *Lespedeza angustifolia;* Fig. 3, *L. capitata;* Fig. 4, *L. hirta* subsp. *hirta;* Fig. 5, *L. hirta* subsp. *curtissii;* Fig. 6, *L. intermedia;* Fig. 7, *L. leptostachya.*

longer than their subtending leaves and bearing up to 16-44 flowers on the terminal half of the peduncle; BRACTEOLES extending to, or slightly beyond, the sinuses of the calyx; PEDICELS 1-2 mm long; FLOWERS 5-8 mm long; CALYX 6-12 mm long, lobed about 0.75 of its length or more, about equaling or slightly exceeding the pod which is easily visible between the lobes; COROLLA white or cream-colored; WINGS about equaling the standard and longer than the keel; PODS ovate or elliptic, 5-8 mm long, moderately to densely appressed-pubescent or appressed-pilose; CLEISTOGAMOUS PODS ovate or elliptic, mostly 5-7 mm long, moderately to densely appressed-pubescent or appressed-pilose, their calyces about equaling the pods; SEEDS mostly black, sometimes tan.

KEY TO SUBSPECIES

Leaflets glabrous, strigose, or pilose above, not silvery; stems villous or pilose ..... subsp. *hirta*

Leaflets silvery with fine, dense, appressed hairs; stems appressed-pubescent or densely short-pilose ..... subsp. *curtissii*

Lespedeza hirta (L.) Hornem. subsp. **hirta**

Hedysarum hirtum L. Sp. Pl. 748 (1753). (T.: *Clayton 510*, Va. [LINN, microfiche!]).

Lespedeza polystachya Michx. Fl. Bor.-Amer. **2:** 71 (1803).

Lespedeza hirta var. *sparsiflora* T. & G. Fl. N. Amer. **1:** 368 (1840).

Lespedeza hirta var. *typica* Schindl. Bot. Jahrb. **49:** 623 (1913).

Lespedeza hirta var. *calycina* Schindl. Bot. Jahrb. **49:** 624 (1913). (T.: *J. Reverchon s. n.*, Dallas Co., Tex., Aug., 1874 [GH!]).

Lespedeza capitata var. *calycina* Fern. Rhodora **43:** 572 (1941).

In open, well-drained old fields, roadsides, sand dunes, and borders of woods from southern Maine, southern Ontario, southern Michigan, northeastern and southern Illinois, southern Missouri, and central Oklahoma south to central Florida and eastern Texas; rare on sandy soils of the Atlantic Coastal Plain (Fig. 4). Flowers from (June) mid-August through October.

Michaux cited *Hedysarum hirtum* L. as a synonym of *L. polystachya*, and his description and plate of *L. polystachya* are identifiable as *L. hirta* (L.) Hornem. Linnaeus (1753) cited Gronovius (1739, p. 173, *Trifolium fruticosum hirsutum* etc.) who, in turn, cited *Clayton 510* which thus serves as the lectotype. Hornemann published *Lespedezia hirta*, incorrectly spelling the name of the genus but validly

publishing the combination. Hornemann described the species and cited the description by Muhlenberg (in Willdenow 1803) who cited *Hedysarum hirtum L.*

I have been unable to locate the type of *Lespedeza hirta* var. *sparsiflora* but have examined a photograph (GH) of it. This plant resembles a shade form of *L. hirta* or possibly the hybrid, *L. hirta* × *violacea.*

Cleistogamous pods occur much less frequently in this subspecies than in *Lespedeza hirta* subsp. *curtissii.* Comments on variation within subsp. *hirta* are included in the discussion under subsp. *curtissii.*

Lespedeza hirta subsp. **curtissii** Clewell Brittonia **16**: 75 (1964). (T.: *Clewell 532*, sandy field along State hwy. 24, 4.5 mi. e. of Ocean, Carteret Co., N. C. 12 Sep. 1961 [IND!]).

Lespedeza hirta sensu Ell. Sketch Bot. S. C. **2**: 207 (1824); non (L.) Hornem. (1815).

In wire grass — long leaf pine — turkey oak sand ridges, among sand pine of the Florida scrub, along roadsides and old fields in dry, sandy soils, and occasionally on loam in frequently burned-over pinelands from southeastern Virginia south along the Atlantic Coastal Plain to central Florida and west to southeastern Alabama and adjacent Florida (Fig. 5). Flowers from mid-August through October.

Plants of this coastal subspecies have been identified as *Lespedeza hirta* var. *appressipilis* Blake. The type of this variety has narrow leaflets, glabrous above, and is identifiable as *L. hirta* × *angustifolia*, and therefore the silvery plants of *L. hirta* from the coastal plain cannot be ascribed to it. Since the coastal plain plants of *L. hirta* are distinct morphologically, geographically, and ecologically from other plants of *L. hirta*, they were recognized as a subspecies (Clewell 1964a). Much of the apparent geographic overlap of these two subspecies (Figs. 4 & 5) reflects the irregular boundary between the Piedmont and the Atlantic Coastal Plain, as well as piedmont-like regions, such as the Tallahassee Red Hills, surrounded by coastal plain sands. I have studied populations of *L. hirta* on the coastal plain from

North Carolina to Louisiana and have discovered a few populations which include plants of both subspecies (Long Co., Ga., *Clewell 923, 937, 939;* Allendale Co., S. C., *Clewell 863, 867, 868* (FSU)). These plants might owe their occurrence to dispersal by man, or they may represent local genetic variation in a subspecies that is generally much more uniform on the coastal plain.

Intergradation between the two subspecies may occur locally where their ranges meet; however, they often remain distinct. On deposit at FSU is a folder with plants from many populations of *Lespedeza hirta* from near the common boundary of the ranges of these subspecies, mostly collected in North Carolina. The nature of the variation encountered near this boundary may be examined from these specimens. Some plants from the pine barrens of New Jersey appear to be intergrades between the subspecies. If this intergradation were more extensive or if the silvery, coastal plain plants occurred with frequency within the range of subsp. *hirta,* then the variation would parallel that existing in *L. capitata.* If this situation occurred, then the identification of too many plants would be arbitrary, and to recognize distinct taxa would be impractical.

I have searched without success for plants of this subspecies near the Gulf Coast from Pensacola to New Orleans.

I can distinguish seven geographic races of *Lespedeza hirta,* which are not distinct enough to be recognized nomenclaturally but which may indicate the directions of evolution within the species. The first two races comprise subsp. *curtissii,* the others subsp. *hirta.*

1. Plants of subsp. *curtissii* from the Carolinas and northern Georgia have stems with erect trichomes, often with the tips of the trichomes bent upwards, and leaflets with trichomes longer than 0.25 mm above.
2. Plants from western Florida have stems appressed-pubescent and leaflets with trichomes mostly shorter than 0.25 mm above. Intergrades between this and the first race occur in southern Georgia and in northeastern and peninsular Florida.

3. Plants roughly from within the Gray's Manual range (New England south to Virginia and west to northern Arkansas) usually have stems densely villous and leaflets moderately appressed-pubescent above.
4. Plants from the same range as race 3 less commonly have stems moderately villous and leaflets glabrous above. Seeds from a plant of race 4 yielded offspring representing both forms (Clewell 1964a).
5. Off the coast of Massachusetts on Nantucket and Martha's Vineyard Islands plants of *L. hirta* resemble those of race 3 but with denser, longer trichomes. On these islands other species of *Lespedeza* tend to have more pronounced induments than elsewhere.
6. In Texas, plants have induments approaching that of subsp. *curtissii* but are not as silvery. In addition the calyces tend to be longer than in other areas, and the calyx lobes are slightly broader, tending to have a cuspidate, rather than an acute, apex. These plants have been recognized as *L. hirta* (or *L. capitata*) var. *calycina*. Fernald (1941, p. 579) discussed the typification of this name.
7. On the Piedmont of the Carolinas and Georgia and extending westward into nearly all of Alabama, Mississippi and southeastern Arkansas are plants with leaflets which are 10% narrower, on the average, (0.6 times as wide as long) and with shorter and denser trichomes on the stems than plants of races 3 and 4.

This variation within *Lespedeza hirta* is correlated with geological provinces and is not clinal. Most of this variation exists in the southern half of its range, while northern populations are uniform. This contrasts with *L. capitata* which is polymorphic in the North and uniform in the South. It seems plausible that geographic differentiation has occurred to a noticeable degree in *L. hirta*, and the activities of man in dispersing seeds and in modifying habitats have caused minor amounts of intergradation to occur between these races. In contrast, *L. capitata*, which is just as polymorphic as *L. hirta*, appears to be a species in which much

less racial differentiation has occurred, or if considerable differentiation had occurred previously, then it was primarily in the North and was mostly obliterated by glaciation.

Lespedeza intermedia (S. Wats.) Britt. Trans. N. Y. Acad. Sci. **12:** 63 (1893). (T.: *M. A. Howe s. n.*, Brattleboro, Windham Co., Vt., Sept., 1891 (GH!)).

Hedysarum violaceum Muhl. in Willd. Sp. Pl. 3: 1195 (1803).

Lespedeza sessiliflora Nutt. Gen. Amer. Pl. 2: 107 (1818).

Lespedeza violacea var. *sessiliflora* G. Don, Gen. Syst. **2:** 307 (1832).

Lespedeza reticulata var. *sessiliflora* Maxim. Acta Horti Petrop. 2: 365 (1873).

Lespedeza reticulata S. Wats. Bibliog. Index 233 (1878), non Pers. 1807.

Lespedeza stuevei var. *intermedia* S. Wats. in Gray, Man. Ed. 6 141 (1890).

Lespedeza frutescens Britt. Mem. Torrey Bot. Club **5:** 205 (1894).

Lespedeza virginica var. *sessiliflora* Schindl. Bot. Jahrb. **49:** 614 (1913).

Lespedeza frutescens var. *acutifructa* Farwell, Rep. Mich. Acad. Sci. **22:** 184 (1921).

STEMS erect or ascending, to about 1 m tall, appressed-pubescent; STIPULES filiform to narrowly subulate, mostly 2-4 mm long; PETIOLES long, the terminal leaflets of the larger leaves being 1-2.5 times longer than the combined lengths of the petiole and rachis and mostly 1-5 times longer on leaves among the racemes; RACHISES of longer terminal leaflets shorter than their petioles, often by 2 times; TERMINAL LEAFLETS oblong, elliptic, or narrowly ovate, the longer up to 4 cm. long and 0.3-0.55 times as wide, glabrous above or, rarely, glabrate along the midvein; RACEMES included or exserted up to 1.5 times beyond their subtending leaves and bearing 4-10 flowers; BRACTEOLES extending up to the sinuses of the calyx; PEDICELS 2-3 mm long; FLOWERS 5-7 mm long; CALYX 3-4.5 mm long and 0.3-0.5 times the length of the pod, lobed about half of its length; COROLLA purple; WINGS at anthesis (nearly) equaling the standard and distinctly longer than the keel; PODS ovate or elliptic, 5-7 mm long, short-appressed-pubescent; CLEISTOGAMOUS PODS commonly present, somewhat orbicular, 2.5-5(-6) mm long, the calyx being 1-2.5 mm long, mostly 0.2-0.33 times longer than the pod.

Dry roadsides, old fields, sand dunes, and borders of woods from southern Maine, southern Ontario, northern Indiana, central Missouri, and eastern Oklahoma south to

Georgia, western Florida, and eastern Louisiana with disjunctions in southeastern Minnesota, northwestern Illinois, and central Texas (Fig. 6). Flowers from late July through early October.

Lespedeza intermedia has long been called *L. frutescens* (L.) Britt., based on *Hedysarum frutescens* L. (T.: *Clayton 174*). Schindler (1913) identified *Clayton 174* as what is now known as *L. violacea* on the basis of its long keel. Blake (1924) recognized the name, *L. intermedia*, and pursued its nomenclatural history. I agree with his position and will not be able to elaborate further on the typification of this species until such time as I am able to examine *Clayton 174*.

Both from the description and a photograph of the type of *Lespedeza frutescens* var. *acutifructa* I am unable to detect any differences between it and typical *L. intermedia*.

Lespedeza intermedia is remarkable for its lack of geographical variation.

A study of phenotypic plasticity in *L. intermedia* by means of reciprocal transplants showed that the size of the leaflets and the length of the internodes vary considerably according to the degree of shading but that pubescence and the floral characters are stable (Clewell 1964b). Leaflet shape may vary nominally but not to the point that it becomes significant in separating species. An understanding of this plasticity is important for accurate identification of species. From observations in the field and from comparisons of field- and greenhouse-grown shoots from the same rhizome, other species exhibit similar plasticity. I have examined a number of specimens which had been misidentified, evidently because they were shade forms of *L. virginica*, that superficially resembled plants of *L. intermedia*, or because they were shade forms of *L. intermedia* that resembled fruiting plants of *L. violacea*.

Chasmogamous and cleistogamous pods of *L. intermedia* can be compared in Fig. 1, a and b.

I have yet to see a specimen of, or visit a population of, *L. intermedia* in sandy pinelands in the Southeast. It is

uncommon in the Southeast except in the Blue Ridge and on the adjacent Piedmont.

Lespedeza leptostachya Engelm. in A. Gray, Proc. Amer. Acad. 12: 57 (1876). (T.: *C. E. Bessey s. n.*, Emmet Co., Iowa, 1871 [MO 146617!]). STEMS erect or ascending, to about 1 m tall, appressed-pubescent; STIPULES filiform to narrowly subulate, up to 5 mm long; PETIOLES short, the terminal leaflets of the larger leaves mostly 1-4 times longer than the combined lengths of the petiole and rachis and at least 4 times longer on leaves among the racemes; RACHISES of the longer leaves shorter than their petioles, often 4 times shorter; TERMINAL LEAFLETS linear or narrowly oblong, up to 3.5 cm long and 0.15-0.25 times as wide, appressed-pubescent above; RACEMES open, mostly 1.5-4 times longer than their subtending leaves, bearing up to about 16-30 flowers; FLOWERS 5-6 mm long; BRACTEOLES equaling or exceeding the bases of the lobes of the calyx; CALYX 4.5-5 mm long, nearly chorisepalous; COROLLA white to light purple; WINGS at anthesis equaling or slightly shorter than the standard and longer than the keel; CLEISTOGAMOUS PODS commonly present in open racemes, nearly orbicular, 3-4 mm long, densely pubescent, exceeded by the calyx, the calyx 4-6 mm long, nearly chorisepalous, the lobes very narrow, bracteoles greatly exceeding the base of the lobes of the calyx; SEEDS greenish-yellow to dark tan.

In upland prairies on gravelly moraines from central Minnesota south to northeastern Illinois and northwestern Iowa (Fig. 7). Flowers from late July through mid September.

Extant specimens of *Lespedeza leptostachya* mostly were collected before 1900, thereby reflecting the intolerance of this species to plowing and grazing. In 1964 I searched for it for two days in the northern tier of counties in Iowa along railroad tracks, in unplowed strips between fields, and in other prairie remnants, including where it had been collected previously. I discovered only one population, that being on a moraine of black, gravelly soil in Cayler Prairie, a preserved virgin prairie about 3 miles west of Lake Okoboji, Dickinson Co., Iowa. Roughly 500 plants grew in a three acre area, and a few plants were scattered elsewhere. *Lespedeza capitata* was also present. Recent plowing of remnant virgin tracts by farmers interested in capitalizing on the Federal Soil Bank Program probably has contributed to the pending extinction of *L. leptostachya*.

Gleason and Cronquist (1964, p. 197) reported *L. leptostachya* near Hawarden, Sioux Co., Iowa. In addition to the two collections from Wisconsin (Fig. 7) Fassett (1939) reported seeing specimens collected in the 1860's from Grant and La Crosse counties. He searched all four localities without discovering plants of *L. leptostachya*. He also saw specimens which I have not seen from northwestern Illinois and from southeastern Minnesota. Steyermark and Swink (1955) reported a recent collection from a dry, gravelly prairie in Cook Co., Illinois.

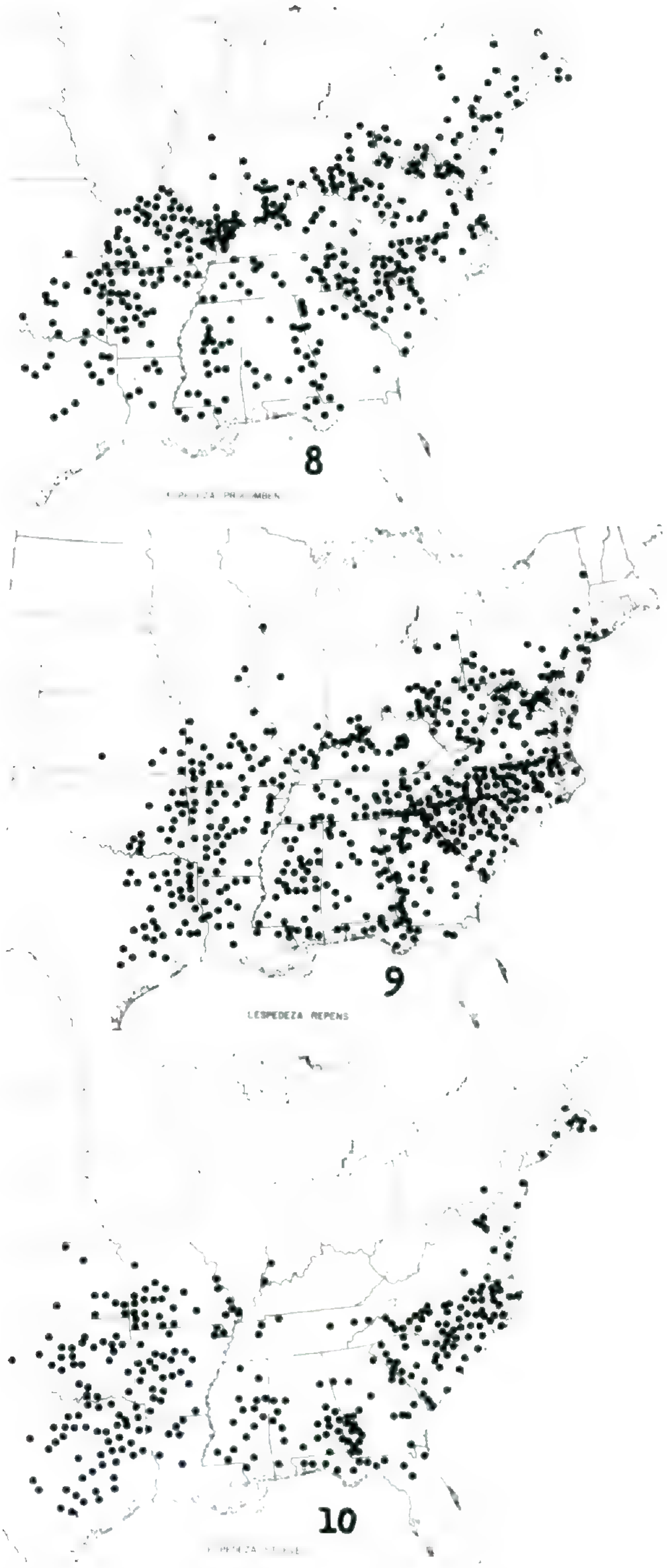
Most collections have cleistogamous pods. This degree of self-pollination helps explain the lack of variation between individuals.

See the comments under *Lespedeza angustifolia* for a comparison with that species.

Lespedeza procumbens Michx. Fl. Bor.-Amer. **2:** 70 (1803). (T: *A. Michaux* [P]).

STEMS procumbent, to about 1.8 m long, short-pilose to nearly villous, usually dense; STIPULES filiform to narrowly subulate, 2-4(-5) mm long; PETIOLES long, the terminal leaflets of the larger leaves mostly 0.5-1.5 times longer than the combined lengths of their petioles and rachises and mostly 1.5-5 times longer on leaves among the racemes; RACHIS of the longer terminal leaflets equaling or shorter than their petioles; TERMINAL LEAFLETS ovate, sometimes elliptic or oblong, the longer ones up to 2.5 cm long and 0.45-0.7 times as wide, sparsely appressed-pubescent, pilose, or rarely densely pilose above; RACEMES mostly 2-7 times longer than their subtending leaves, occasionally 2 per node, bearing up to 8-12(-14) flowers scattered along the terminal half of the peduncle; PEDUNCLES pilose; PEDICELS 0.5-1.5(-2) mm long; FLOWERS 5-9 mm long; BRACTEOLES extending about to the base of the lobes of the calyx; CALYX 2-4 mm long and extending (nearly) half the length of the pod, lobed 0.5-0.7 of its length; COROLLA purple; WINGS at anthesis about as long as the keel and shorter than the standard; STANDARD equaling or slightly longer than the keel; PODS elliptic, about 5 mm long, short appressed-pubescent to nearly glabrous; CLEISTOGAMOUS PODS commonly present, in axillary clusters or clustered near the apexes of peduncles, elliptic to orbicular, 3.5-5 mm long, mostly sessile, their calyces 1-2 mm long and 0.2-0.3 times the length of the pod; SEEDS greenish-yellow to dark tan.

Dry roadsides, old fields, and open woods from southern New England, central Illinois, and central Oklahoma south to Georgia, western Florida, and eastern Texas (Fig. 8).



Figs. 8-10. Distribution by county of 3 taxa. Fig. 8, *Lespedeza procumbens;* Fig. 9, *L. repens;* Fig. 10, *L. stuevei.*

Flowers from (mid-June) late August through September.

Mlle. A. Lourteig kindly compared a typical plant of *L. procumbens* from Brown Co., Indiana, with the type in the Michaux Herbarium (P) and wrote me that, "it matches perfectly." She said it did not match a plant of typical *L. repens* which I had also included. On the Atlantic Coastal Plain I have seen *L. procumbens* only on clays and loams, not on soils of pure sand. I have not detected any geographic variation in *L. procumbens*.

There is close resemblance between *Lespedeza procumbens* and *L. repens*. While *L. procumbens* has stems and peduncles pilose, typically 8-12 flowers per raceme, and cleistogamous pods either pedunculate or axillary, *L. repens* has stems and peduncles sparsely short-appressed-pubescent, typically 4-8 flowers per raceme, and cleistogamous pods commonly pedunculate. Pubescence alone is quite sufficient in distinguishing them.

Lespedeza repens (L.) Bart. Prod. Fl. Phil. 2: 77 (1817) in part. (T.: *Clayton 85, Va.* [BM]).

Hedysarum repens L. Sp. Pl. 749 (1753).

Hedysarum prostratum Muhl. in Willld. Sp. Pl. 3: 1200 (1803).

Lespedeza prostrata Nutt. Gen. Amer. Pl. 2: 107 (1818).

STEMS procumbent or sometimes ascending when young, to about 1 m long, sparsely short-appressed-pubescent; STIPULES subulate, 1.5-3(-4) mm long; LEAVES generally of the same size on a stem, gradually becoming smaller towards the tip with an occasional axillary bud expanding into one very small leaf; PETIOLES long, the terminal leaflets of the larger leaves being mostly 1-4 times longer than the combined lengths of their petioles and rachises and mostly 2-5 times longer on leaves among the racemes; RACHISES of the longer terminal leaflets equaling or shorter than their petioles; TERMINAL LEAFLETS membranous, elliptic to (ob-)ovate, the longer ones up to 2.5 cm long and 0.33-0.8 (mostly 0.45-0.7) times as wide, glabrous or sparsely appressed-pubescent above, green in color below; RACEMES mostly 2-7 times longer than their subtending leaves, sometimes 2 per node, bearing 4-8(-12) flowers; PEDUNCLES filiform, appressed-pubescent; PEDICELS 0.5-3(-4) mm long; BRACTEOLES extending up to the base of the lobes of the calyx; FLOWERS 5-7(-8) mm long; CALYX 2-4 mm long, lobed about half its length and extending (nearly) half the length of the mature pod; COROLLA purple; WINGS about equaling or shorter than the keel; STANDARD equaling or slightly exceeding the keel; PODS ovate or orbicular, sometimes slightly asymmetrical, 4-5 mm long,

sparsely short-appressed-pubescent; CLEISTOGAMOUS PODS commonly present, orbicular or occasionally somewhat elliptical, rarely asymmetrical, 3-4(-5) mm long, mostly pedunculate, sometimes a few pods in axillary clusters, their calyces being up to 0.25-0.5 times the length of the mature pod; SEEDS greenish-yellow.

Dry roadsides, old fields, borders of woods, and sandy pinelands from Long Island, Ohio, central Missouri and south-central Kansas south to northern Florida and eastern Texas, also along the Mississippi River to southwestern Wisconsin (Fig. 9). Flowers from (mid-April) late May through October.

The lectotype of *Lespedeza repens, Clayton 85* (BM), was cited by Gronovius (1739, p. 86) as *Hedysarum caulibus procumbentibus*, etc. Gronovius also cited a plant from Ceylon under this name by referring to a plate in Dillenius' Hortus Elthamensis. The plant from Ceylon is not a *Lespedeza* but might be an *Alysicarpus* (Robson, pers. com.) or a *Desmodium* (Britton 1893). Robson, who kindly examined *Clayton 85* for me, questioned the name, *Lespedeza (Hedysarum) repens*, because Linnaeus' description matches more closely the plant from Ceylon than *Clayton 85* which lacks obcordate leaflets described by Linnaeus. Two possibilities may explain this discrepancy; over the years the lower leaflets, which are often the only obcordate ones in *L. repens*, were lost from *Clayton 85*, or Linnaeus based his description on additional plants that he did not cite, such as 921-42 in the Linnaean Herbarium. Since Linnaeus referred to *Clayton 85* by citing Gronovius and since he described *H. repens* as occurring only in Virginia, then I recognize the Linnaean name as legitimate. Britton (1893) and Schindler (1913, p. 593) both examined *Clayton 85* and recognized it as the lectotype.

Plants of *Lespedeza repens* in the southeastern states often bloom in the late spring. These plants may have at least some of their stems ascending while in flower. Later in the year continued growth of these same stems will provide sufficient weight to make them lie procumbent. Otherwise, I have detected no geographic variation in *L. repens*; however, I have seen an occasional specimen from the lower

Mississippi Valley with fruits resembling those of *L. violacea* in size and shape.

Plants of *Lespedeza repens* are easily distinguished from *L. violacea* in the field; however, pressed specimens of these species in fruit are often misidentified. The most reliable character in separating such specimens is the ratio between the length of the mature, cleistogamous pod and its subtending calyx. In *L. repens* (Fig. 1e) the calyx extends at least a quarter of the way up the pod (not including the style). In *L. violacea* (Fig. 1d) the calyx reaches up to two tenths of the way up the pod, usually much less. Other characters are: length of stipules — 1.5-3 mm in *L. repens*, up to 2.5-6 mm long in *L. violacea;* cleistogamous pods — mostly pedunculate, 3-4 mm long, and symmetrical in *L. repens*, mostly axillary, 3-7 mm long, and often asymmetrical in *L. violacea;* leaves generally of one size, though gradually becoming somewhat shorter towards the apex of the stem in *L. repens*, leaves of two or more distinct sizes, attributable to one or few smaller leaves of different sizes occurring in the axils of the larger leaves in *L. violacea*.

Lespedeza stuevei Nutt. Gen. Amer. Pl. **2:** 107 (1818). (T.: *W. Stüve* [PH.]).

STEMS erect or ascending, to about 1.8 m tall, densely appressed-pubescent or pilose; STIPULES filiform to narrowly subulate, up to 5 mm long; PETIOLES long, the terminal leaflets of the larger leaves being 0.5-2 times longer than the combined lengths of the petiole and rachis and mostly 1-5 times longer on leaves among the racemes; RACHISES of the longer terminal leaflets shorter than their petioles; TERMINAL LEAFLETS elliptic or oblong, the longer ones up to 4 cm long and 0.3-.55 times as wide, uniformly appressed-pubescent, occasionally pilose, rarely sparsely appressed-pubescent along the midvein above; RACEMES included or exserted up to 1.5 times beyond their subtending leaves and bearing up to (6-)8-14 flowers; PEDICELS up to 2 mm long; BRACTEOLES extending about to the base of the lobes of the calyx; FLOWERS 4.5-6.5 mm long; CALYX 3-5 mm long, extending (nearly) half the length of the pod; lobed about 0.5-0.6 of its length, COROLLA purple; WINGS at anthesis (nearly) equaling the standard and distinctly longer than the keel; PODS ovate or elliptic, mostly 5-6 mm long, sparsely short-appressed-pubescent to densely appressed-pilose; CLEISTOGAMOUS PODS commonly present, ovate or elliptic, mostly 4-6 mm long, sparsely short-appressed-pubescent to densely appressed-pilose, the calyx being 0.3-0.4 times the length of the pod.

Dry roadsides and old fields, borders of dry woods, and open sandy pinelands along the Atlantic Coast from Massachusetts to North Carolina, then west to southern Indiana and eastern Kansas and south to northern Florida and central Texas (Fig. 10). Flowers from (June) August through October.

Lespedeza stuevei was named for W. Stüve and was spelled *L. stüvei* by Nuttall (1818) and some subsequent authors. Article 73 of the International Code of Botanical Nomenclature (Lanjouw 1961) necessitates the orthographic change to *stuevei*. N. K. B. Robson (pers. com.) stated, "*Medicago caule erecto vix ramoso, racemo dense spicato terminatrice* (Gronov., Fl. Virgin.: 86) appears to belong to this species, according to the Clayton specimen in our Herbarium (BM). Linnaeus did not take it up in Sp. Pl."

Geographic variation within *Lespedeza stuevei* is pronounced and recognition of two subspecies is perhaps warranted. Plants from the Ozark Plateau and from along the Atlantic coast above North Carolina have long trichomes. The stems of these plants are often pilose, and the otherwise brown pods at maturity are often hoary with appressed trichomes. Plants from much of Texas and from the southeastern states, particularly in dry pinelands, have exceptionally fine, short, appressed trichomes which, though dense, may barely be discerned without a lens. Specimens of these southeastern plants sometimes have been mistaken for *L. intermedia*. I have seen two nearly glabrous plants of *L. stuevei*: *Kral 8159* (LAF) and *Cocks* in 1900 (NO) from Jackson and Rapides Parishes, respectively, Louisiana.

Plants of *Lespedeza stuevei* or *L. virginica* with the larger terminal leaflets about 0.3 times as wide as broad must be identified arbitrarily. Most collections of such plants are probably hybrids. I have examined many populations in which both species were present, and in nearly all populations the great majority of plants can be identified easily to one or the other species. Undoubtedly these species are closely related, both phenetically and genetically, but there is little reason to consider lumping them.

Lespedeza texana Britt. in Small, Fl. S. E. U. S. 641 (1903). (T.: *A. Arthur Heller 1914*, Kerrville, Kerr Co., Tex., 19-26 June 1894 [NY!]).

STEMS erect up to about 1.5 dm, the more distal portions procumbent, up to 1.5 m long, appressed-pubescent to short-pilose; STIPULES filiform, the longer ones (3-)4-8 mm long; PETIOLES long, the terminal leaflets of the larger leaves being 1-3 times longer than the combined lengths of their petioles and rachises and mostly 2-5 times longer on leaves among the racemes; RACHISES of the longer terminal leaflets mostly shorter than, or about equaling, their petioles; TERMINAL LEAFLETS firm-textured, elliptic, the longer ones up to 3.5 cm long and 0.35-0.55 times as wide, glabrous, glabrate, or sometimes short-pilose, above, gray-green to white below; RACEMES mostly 2-7 times longer than their subtending leaves, sometimes 2 or 3 per node, bearing 4-8(-10) flowers; PEDUNCLES appressed-pubescent or short-pilose; PEDICELS (1-)3-5 mm long; BRACTEOLES extending to the base of the lobes of the calyx; FLOWERS 5.5-8.5 mm long; CALYX 2-4 mm long, and extending (nearly) half the length of the pod, lobed about half its length; COROLLA purple; WINGS shorter than or about equaling the keel; STANDARD equaling the keel; PODS ovate, 6-7 mm long; sparsely short-appressed-pubescent; CLEISTOGAMOUS PODS commonly present, 4-6.5 mm long, ovate, sometimes asymmetrical, axillary or peduncu-late, their calyces being 0.1-0.3 times the length of the pod.

In thin, rocky soil of scarp woodlands on or near the Edwards Plateau in central Texas; disjunction in eastern Coahuila, Mexico (Fig. 11). Flowers from mid-June through mid-October.

I did not recognize *Lespedeza texana* as a species until I saw living plants of it in natural populations. Its most distinctive characters are not preserved in dried specimens. Its long stipules, up to 4-8 mm, often break off when dry. The somewhat coriaceous texture to the leaflets is easily overlooked on mounted specimens. The greenish-gray to white undersurface of the leaflets contrasts with the green undersurfaces in related species; this color escapes attention or is disregarded until seen in the field. The habit, which is entirely unlike that of any other American species, is the most striking character in the field, yet it cannot be recognized from pressed specimens. The stems are erect up to about 15 cm high, the next 10 cm are arching, and the rest of each stem, which may extend over a meter in length, is trailing. Other distinctive characters are the long, cleistog-

amous pods, 4-6.5 mm long (as compared to 3-4 mm long in *L. repens*), and the keel and wing petals which are about of equal lengths (in contrast to *L. violacea*). I have seen only one plant in flower, and it was greenhouse-grown. Its flowers were uniformly dark purple and were more deeply pigmented than the flowers of plants of the other species.

Although I do not know *Lespedeza texana* in the field as well as I know the other species, I believe that *L. texana* tends to be less weedy than the other species and does not invade roadsides. It is essentially allopatric; I have collected *L. procumbens* with it in Robertson Co., Texas, and know of no other sympatric populations. The collection from Coahuila is *Palmer 249* (PH) from Mt. Caracol, 21 miles southeast of Monclova.

Lespedeza violacea (L.) Pers. Syn. 2: 318 (1807). (T.: *Kalm* [LINN 921-41]).

Hedysarum frutescens L. Sp. Pl. 748 (1753), non Muhl. in Willd. 1803.

Hedysarum violaceum L. Sp. Pl. 749 (1753).

Hedysarum divergens Muhl. in Willd. Sp. Pl. 3: 1196 (1803).

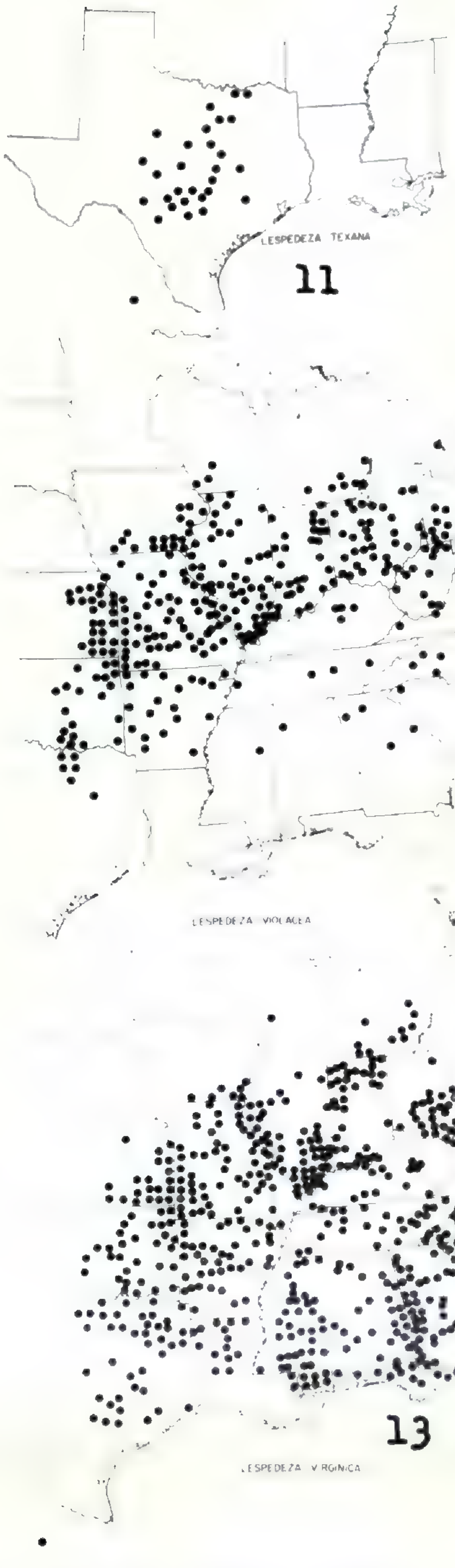
Lespedeza divergens Pursh, Fl. Amer. Sept. 2: 481 (1814).

Lespedeza violacea var. *divergens* G. Don, Gen. Syst. 2: 307 (1832).

Lespedeza violacea var. *prairea* Mackenz. & Bush, Trans. Acad. Sci. St. Louis **12:** 14 (1902). (T.: *B. F. Bush 93*, common, Lee's Summit, Jackson Co., Mo., 2 Sept. 1895 [MO!, isotype NY!]).

Lespedeza prairea Britt. in Small, Fl. S. E. U. S. 641 (1903).

STEMS erect to weakly ascending, to about 0.7 m tall, sparsely appressed-pubescent; STIPULES filiform, up to 2.5-6 mm long; LEAVES generally of several different sizes on a stem with axillary buds commonly expanding into single, smaller leaves of various sizes; PETIOLES long, terminal leaflets of the larger leaves mostly 0.5-1.5 times longer than the combined lengths of their petiole and rachis and mostly 1-4 times longer on leaves among the racemes; RACHISES of the longer leaflets shorter than their petioles; TERMINAL LEAFLETS membranous, elliptic or ovate, the longer ones up to 4.5 cm long and 0.35-0.7 times as wide, glabrous or sometimes glabrate above, light green or green below. RACEMES exserted up to 2-5 times beyond their subtending leaves or, uncommonly, all included within their subtending leaves, often 2 per node, bearing 4-6(-8) flowers; PEDUNCLES filiform, appressed-pubescent; PEDICELS 0.5-3 mm. long; BRACTEOLES extending about to the base of the lobes of the calyx; FLOWERS 5.5-9 mm long; CALYX 3-6 mm long, about half the length of the mature pod; lobed about 0.6 of its length, COROLLA purple; WINGS and STANDARD distinctly shorter than,



Figs. 11-13. Distribution by county of 3 taxa. Fig. 11, *Lespedeza texana;* Fig. 12, *L. violcea;* Fig. 13, *L. virginica.*

or, uncommonly, nearly equaling the keel; PODS 5-7.5 mm long, glabrate, sometimes asymmetrical; CLEISTOGAMOUS PODS commonly present, elliptic to orbicular, sometimes asymmetrical, (3-)4.5-6 mm long, usually axillary, sometimes (short-) pedunculate, their calyces being up to 0.2 (rarely 0.25) times the length of the pod, mostly shorter.

In dry old fields, roadsides, prairies, and open woods from southern New England to southern Wisconsin and eastern Kansas south to central Georgia and northeastern Texas (Fig. 12). Flowers from (mid-July) August through September.

Determining the correct name and its typification for this species is difficult, and I cannot feel certain that *L. violacea* is the legitimate name, since I have not seen the pertinent specimens in European herbaria. I am dependent upon the discussion by Schindler (1913, pp. 591-593) and personal correspondence received from N. K. B. Robson and D. Ockendon. *Lespedeza violacea* is based on *Hedysarum violaceum* L. Linnaeus' description of *H. violaceum* fits *L. intermedia*, *L. procumbens*, and *L. repens*, as well as *L. violacea*. He referred to Gronovius (1739, p. 87) where *Clayton 103* is cited. This specimen is identifiable as *Psoralea psoralioides* (Walt.) Cory (= *P. melilotoides* Michx.). Linnaeus probably did not have *Clayton 103* before him when he described *H. violaceum*. More than likely he described *H. violaceum* from the Kalm specimen, 921-41, in the Linnaean Herbarium. This sheet bears Linnaeus' annotation, "violaceum", and the number, 21, which corresponds to the number of *H. violaceum* in Species Plantarum. I was unable to determine from the microfilm of 921-41 whether this specimen was of *L. violacea* or was a shade form of *L. intermedia*. Britton (1893) and Schindler (1913) both identified it as *L. intermedia* of this paper. For purposes of nomenclatural stability I am assuming that it is *L. violacea* until I have occasion to examine it in person. If this specimen is not what I now call *L. violacea*, then *L. frutescens*, based on *Hedysarum frutescens* L., would be the next name in priority. In describing *H. frutescens*, Linnaeus referred to Gronovius (1739, p. 174) who cited *Clayton 174* (BM), a specimen identified as *L. violacea* by Schindler (1913) on

the basis of the long keel. The epithet, *frutescens*, has been applied to *L. capitata* and more recently to *L. intermedia* by Britton (1894), Robinson & Fernald (1908), and others. I would consider *L. frutescens*, applied to what I am now calling *L. violacea*, a *nomen confusum* and would reject it under Article 69 of the Code of Nomenclature (Lanjouw 1961). *Lespedeza divergens* (Muhl.) Pursh would then become the name of this species.

By noting the year of collection of specimens identified as *L. prairea* deposited at NY, I assume that Britton had 17 collections before him when he first recognized them as a species. These plants, as well as the type, resemble closely typical *L. violacea* as it occurs in full sunlight. Field observations indicate that the lengths of the internodes and leaflets are highly variable, depending upon the amount of shading, just as was determined in *L. intermedia*. Four plants of *L. violacea* grown in full sunlight from seeds of *Clewell 1563* had internodes and leaflets about three times shorter than did the parent plant which was collected in a woods in Martin Co., Indiana.

See the discussion under *L. repens* for a comparison with that species. Chasmogamous and cleistogamous pods can be compared in Fig. 1, c and d.

Lespedeza violacea is common west of the Mississippi River and fairly common north of the Ohio River. It becomes increasingly rare in the southeastern states and to my knowledge has not been collected on the sandy soils of the Atlantic Coastal Plain.

Lespedeza virginica (L.) Britt. Trans. N. Y. Acad. Sci. **12:** 64 (1893). (T.: *Clayton 191* [BM]).

Medicago virginica L. Sp. Pl. 778 (1753).
Hedysarum reticulatum Muhl. in Willd. Sp. Pl. 3: 1194 (1803).
Lespedeza sessiliflora Michx. Fl. Bor.-Amer. 2: 70 (1803).
Hedysarum sessiliflorum Lam. Encycl. 4: 414 (1804).
Lespedeza reticulata Pers. Syn. 2: 318 (1807), non S. Wats. 1878.
Lespedeza angustifolia Darl. Fl. Cestr. 81. (1826), non Pursh 1814.
Lespedeza violacea var. *reticulata* G. Don, Gen. Syst. 2: 307 (1832).
Lespedeza violacea var. *angustifolia* T. & G. Fl. N. Amer. 1: 367 (1840).
Lespedeza reticulata var. *angustifolia* Maxim. Acta Horti Petrop. 2: 366 (1873).

Lespedeza virginica var. *typica* Schindl. Bot. Jahrb. **49**: 614 (1913). STEMS erect or ascending, to about 1.6 m tall, appressed-pubescent or sometimes short-pilose; STIPULES filiform to narrowly subulate, up to 6 mm long; PETIOLES long, the terminal leaflets of the larger leaves being 0.5-1.5 times longer than the combined lengths of their petioles and rachises and mostly 1.5-3 times longer on leaves among the racemes; RACHISES of the longer terminal leaflets generally half as long as their petioles; TERMINAL LEAFLETS linear or narrowly oblong, the wider ones sometimes narrowly lanceolate, the longer ones up to 4 cm long and 0.1-0.3 times as wide, sparsely appressed-pubescent, sometimes only along the midvein, or rarely glabrous above; RACEMES included or exserted up to 1.5 times beyond their subtending leaves and bearing 4-8(-14) flowers; PEDICELS up to 2 mm long; BRACTEOLES extending about to the base of the lobes of the calyx; FLOWERS 5-7 mm long, CALYX 2-4 mm long, and extending (nearly) half the length of the pod; lobed about half its length, COROLLA purple; WINGS nearly equal or slightly shorter than the standard and slightly longer than the keel; PODS 4-7 mm long, sometimes slightly asymmetrical, minutely to densely appressed-pubescent; CLEISTOGAMOUS PODS commonly present, 4-5 mm long, sometimes slightly asymmetrical, their calyces being 0.2-0.3 times the lengths of the pods.

In dry old fields, roadsides, prairies, borders of woods, and open sandy pineland from central New England, southern Michigan, southern Iowa, and eastern Kansas south to northern Florida and eastern Texas; disjunctions in southern Wisconsin and central Nuevo León, Mexico (Fig. 13). Flowers throughout August and September.

N. K. B. Robson (pers. com.) said that the lectotype, *Clayton 191* (BM), is identifiable as *Lespedeza virginica* as I have described the species. Darlington (1826) published a name, "*L. angustifolia* ? Ell." which from description is most likely a hybrid between *L. capitata* and a purple flowered species. I have cited this name with *L. virginica*, because Torrey and Gray (1840) evidently used Darlington's citation for the basionym of *L. violacea* var. *angustifolia*, and Maximowicz (1873) cited the Torrey and Gray name as a synonym of his *L. reticulata* var. *angustifolia*. It is clear from the discussion by Torrey and Gray that they were describing *L. virginica*.

The Mexican collection is *C. H. Muller 2820*, scattered in open pine forest, LaTrinidad, Municipio de Montemorelos, Nuevo León, 18 Aug. 1936 (LL, MO, TENN). Of the plants

of *Lespedeza virginica* that I have examined from Tennessee north into the Ohio River Valley, many appear to have the denser pubescence of *L. stuevei*. These plants have been identified as *L. virginica* var. *deamii* M. Hopkins; an example is *Bartley & Pontius*, Jackson Co., Ohio, 1935 (OS). Although rare or absent in much of this region, *L. stuevei* may have been more common there recently, and the pubescent forms of *L. virginica* might represent the products of introgression with *L. stuevei*.

PUTATIVE HYBRIDS

Natural hybridization in *Lespedeza* has been suspected by many authors, including Mackenzie (1907), Wiegand & Eames (1925), Palmer & Steyermark (1935), and Fernald (1950). Of the 55 possible interspecific hybrid combinations between the 11 native American species, 19 are not expected because the ranges of three, *L. angustifolia*, *L. leptostachya*, and *L. texana*, do not overlap with the ranges of some of the other species and each other. Of the remaining 36 possible combinations, I have observed 17 in natural populations and have identified 16 additional combinations from dried specimens (Table I, Figs. 12-16).

The high frequency of populations containing hybrids of *Lespedeza* makes the genus suitable for the study of hybridization in the field by autumn classes in taxonomy. In trying to locate hybrids, one should familiarize himself with the species in a large population. Such populations are common on top of road embankments in hilly country. If both white- and purple-flowered species are present, pink-flowered plants are likely to be hybrids. If both procumbent and erect species are present, plants with weakly ascending stems may be hybrids. All species have calyces extending either about half the way up the chasmogamous pods or exceeding the pod. Plants with calyces extending about two thirds of the way up the pods usually are hybrids.

Since a few hybrids occur in nearly every population, it is not surprising that some have been named as species or infraspecific taxa. Sixteen names have been applied to various hybrid combinations by other authors; I have recog-

TABLE I

The Naturally Occurring Putative Hybrids of Lespedeza, Their Relative Abundance, and the Number of Progeny Tests Completed on Each.

Hybrid	Figure	Abundance	Progeny Tests	
angustifolia × capitata	15	rare		
angustifolia × hirta	16	common	1	
angustifolia × repens	15	rare		
angustifolia × stuevei	15	rare	2	
angustifolia × virginica	—	rare		
capitata × hirta	16	abundant		
capitata × intermedia	15	rare		
capitata × leptostachya	16	rare		
capitata × repens	17	rare		
capitata × stuevei	15	rare		
capitata × violacea	14	common		
capitata × virginica	16	common		
hirta × intermedia	14	abundant	8	
hirta × procumbens	16	abundant	2	
hirta × repens	18	common	1	
hirta × stuevei	17	abundant	4	
hirta × violacea	15	rare		
hirta × virginica	18	abundant	5	
intermedia × procumbens	17	rare	1	
intermedia × repens	15	rare		
intermedia × stuevei	18	rare		identifications very tentative
intermedia × violacea	14	rare		
intermedia × virginica	14	rare		
procumbens × repens	15	rare		
procumbens × stuevei	18	rare		
procumbens × violacea	15	rare		
procumbens × virginica	17	abundant		
repens × stuevei	17	rare		
repens × violacea	17	rare		
repens × virginica	18	abundant	2	
stuevei × violacea	17	rare		
stuevei × virginica	18	abundant		
violacea × virginica	15	common		

Relative abundance probably reflects the abundance of the parental species more than their genetic compatibility.

nized only 12 "good" taxa, including subspecies. Most of the previous taxonomic difficulties encountered in *Lespedeza* have stemmed from a failure to recognize hybrids. Only a small portion of the difficulties in conceptualizing and

identifying the "good" taxa during this century have resulted from phenotypic plasticity (c.f. *L. violacea*, sun and shade forms) or from failure to delimit taxa precisely.

Whether or not any of these hybrid combinations merit nomenclatural recognition is a matter of opinion. I choose not to recognize any hybrids with binomials or infraspecific names. If one combination is named, then the remaining 31 combinations logically should be named. The recognition of even one hybrid would tend to confuse specific delimitations and make the construction and use of keys difficult at best. If only the common hybrids are named, or if only the rather distinctive hybrids from contrasting parental species are named, then the decision as to which are common or which are distinctive becomes arbitrary, not biological, because most possible hybrids exist, many with frequency. It could be argued that those hybrids that are similar could be lumped under one name. For example, the name *Lespedeza* × *nuttallii*, based on *L. hirta* × *intermedia*, could also apply to *L. hirta* × *stuevei* and *L. hirta* × *virginica*. I do not favor this procedure, because the binominal becomes meaningless in denoting the parental species involved. Furthermore, the decision as to what hybrid combinations should be applied to which binomial would be arbitrary. For example, enough similarity exists to include plants of *L. capitata* × *intermedia* under two names, *L.* × *nuttallii* and *L. simulata* (based on *L. capitata* × *virginica*). Even if only one hybrid combination was applied to one name, in practice it would be impossible to identify many hybrids correctly. For instance, many notomorphs of *L. hirta* × *intermedia*, *L. hirta* × *stuevei*, and *L. hirta* × *virginica* are indistinguishable from one another. Regardless of how many epithets are applied to hybrids, each clutters the nomenclature, since formulas can be employed just as easily. The only possible justification for applying names to hybrids in *Lespedeza* would be to ease the filing of herbarium specimens, but hybrids can be filed conveniently in one or more covers at the end of the genus.

The only hybrid combinations that are treated further are

those which have been given previous nomenclatural recognition.

Lespedeza angustifolia × hirta

Lespedeza hirta var. *oblongifolia* Britt. Trans. N. Y. Acad. Sci. **12:** 66 (1893). (T.: *J. B. Brinton s.n.*, sandy pine barrens, Egg Harbor, Atlantic Co., N. J., 10 Aug. 1879 [NY!]).

Lespedeza oblongifolia W. Stone, Pl. So. New Jersey 509 (1912).

Lespedeza hirta var. *appressipilis* Blake, Rhodora **26:** 32 (1924). T.: *A. H. Curtiss 639*, dry pine barrens, Duval Co., Fla., Oct. [US 517623!]).

Plants that I assign to *Lespedeza hirta* subsp. *curtissii* have been called *L. hirta* var. *appressipilis* Blake by Fernald (1941, 1950), Wilbur (1963), and others. Blake cited three specimens of var. *appressipilis*, two of which matched his diagnosis and my concept of subsp. *curtissii*. The third specimen, *Curtiss 639* which he assigned as the type, does not resemble subsp. *curtissii* or match his diagnosis. Its leaflets are glabrous above (not silvery with dense, fine, appressed trichomes), and the leaflets are narrowly obovate and slightly less than half as wide as long (not ovate and more than half as wide as long). It appears to be a notomorph of *L. angustifolia* × *hirta*. Blake's choice of a type for var. *appressipilis* was unfortunate, because it necessitated another name for the taxon he delineated.

Lespedeza capitata × hirta

Lespedeza longifolia DC. Prodr. 2: 349 (1825). (T.: *Bonjean, s. n.* in Louisiana [G]).

Lespedeza capitata var. *longifolia* T. & G. Fl. N. Amer. 1: 368 (1840).

Lespedeza capitata var. *hirtiformis* Fern. Rhodora **40:** 437 (1838). (T.: *M. L. Fernald & Bayard Long 7481*, border of dry woods, Zion's Church, n. w. of Whaleyville, Nansemond Co., Va., 17 Sept. 1937 [GH!]).

Lespedeza hirta var. *longifolia* Fern. Rhodora **43:** 585 (1941).

Lespedeza hirta var. *dissimulans* Fern. Rhodora **43:** 585 (1941). (T.: *M. L. Fernald & Bayard Long 13966*, valley of the Penobscot River, dry thickets on clay terraces, Veazie, Penobscot Co., Maine, 9 Sept. 1916 [GH!, *ex* NEBC]).

Without having seen the *Bonjean* specimen, it is problematic whether the epithet, *longifolia* DC., is a synonym of the above formula or of *Lespedeza capitata*. A photograph

of this specimen in the Gray Herbarium resembles *L. angustifolia* × *hirta*, but *L. angustifolia* has been collected no further west than Mississippi. That DeCandolle recognized *L. angustifolia*, *L. capitata*, and *L. hirta*, as well as *L. longifolia*, is evidence that the Bonjean collection represents something else than the first three species mentioned. From DeCandolle's descriptions I am not convinced, though, that he understood *L. angustifolia* or the variation in *L. capitata*. Torrey and Gray (1840), Britton (1893) and others have extended *L. capitata* var. *longifolia* to include certain typical specimens of *L. capitata*. Fernald (1941) and others have considered the epithet *longifolia* DC. in its various combinations synonymous with the epithet *oblongifolia* Britt. in its combinations. The latter epithet I believe applies to *L. angustifolia* × *hirta*. The Drummond specimen from Louisiana (photograph in Fernald, 1941) appears to be *L. capitata* × *hirta*, in that it has the elongate rachis of *L. capitata* and the elongate raceme of *L. hirta*.

Fernald cited only the type and an isotype with his diagnosis of *Lespedeza capitata* var. *hirtiformis*, and he reassigned these specimens to *L. capitata* var. *calycina* (Schindl.) Fern. three years later (Fernald 1941). Of the four specimens at the Gray Herbarium which were annotated by Fernald as *L. hirta* var. *dissimulans*, one is *L. capitata* and the rest are probably *L. capitata* × *hirta*, including the type.

Lespedeza capitata × violacea

Lespedeza manniana Mackenz. & Bush, Trans. Acad. Sci. St. Louis **12:** 15 (1902). (T.: *Kenneth K. Mackenzie s. n.*, frequent on dry hills, Swope Park, Jackson Co., Mo., 23 Aug. 1896 [NY!]).

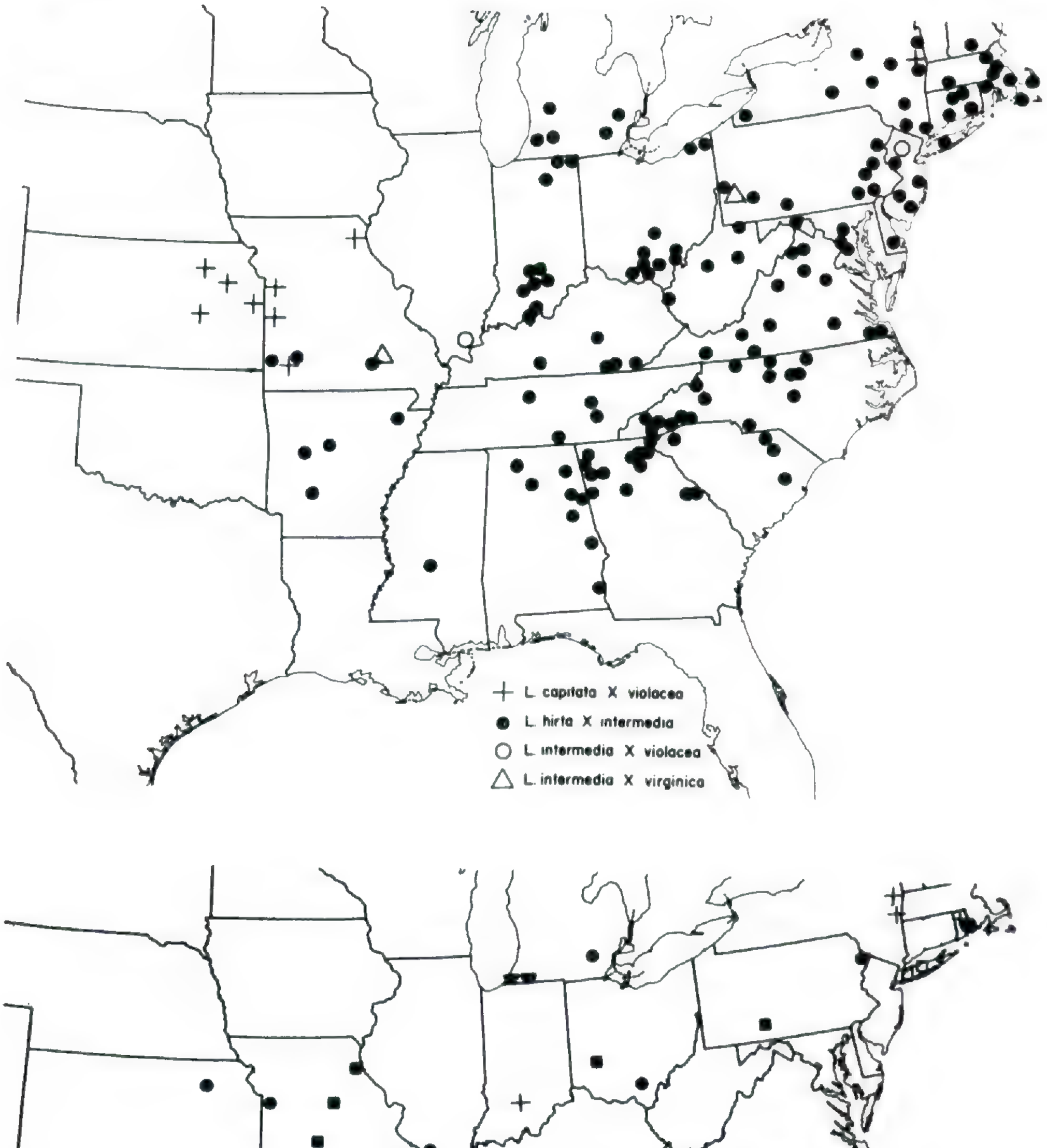
Lespedeza nuttallii var. *manniana* Gl. Britt. & Brown Fl. 2: 434 (1952).

Lespedeza capitata × virginica

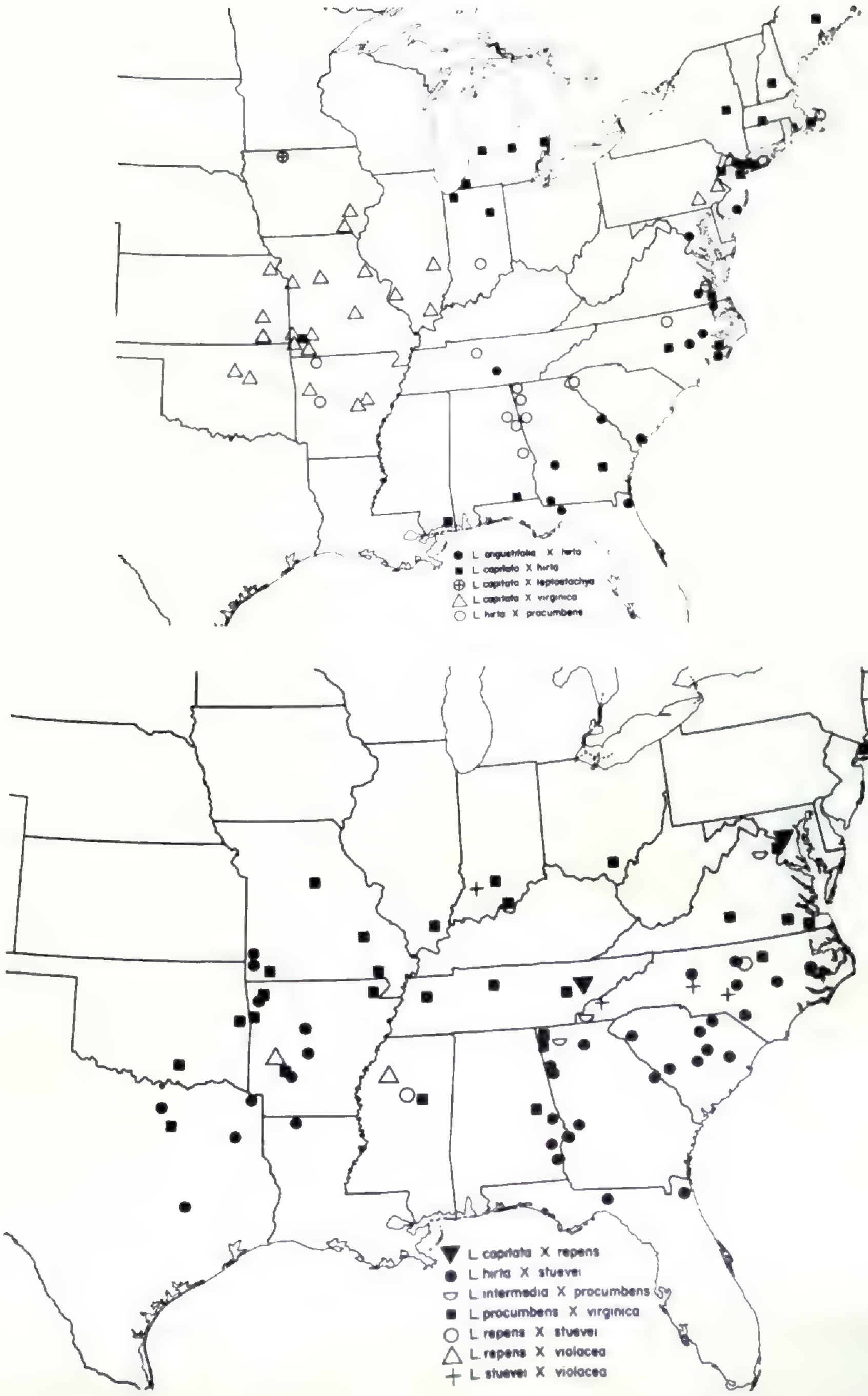
Lespedeza simulata Mackenz. & Bush, Trans. Acad. Sci. St. Louis **12:** 15 (1902). (T.: *B. F. Bush s. n.*, Newton Co., Mo., 29 Aug. 1893 [MO 146712!]).

Lespedeza hirta × intermedia

Lespedeza nuttallii Darl. Fl. Cestr. Ed. 2, 420 (1837). (T.: *Nuttall s. n.*, Sussex Co., Delaware [PH!]).



Figs. 14-15. Distribution by county of 14 hybrids.



Figs. 16-17. Distribution by county of 12 hybrids.

Lespedeza virgata Nutt. in T. & G. Fl. N. Amer. 1: 368 (1840), non DC. 1825. (T.: *Nuttall s. n.*, cited above).
Lespedeza intermedia var. *hahnii* Blake, Rhodora **26:** 32 (1924).

T.: *W. L. Hahn s. n.*, vicinity of Bascom, Ohio Co., Ind., Aug., 1906 [US 609738!]).
Lespedeza intermedia f. *hahnii* M. Hopkins, Rhodora **37:** 265 (1935).
Lespedeza nuttallii var. *nuttallii* Gl. Britt. & Brown Fl. 2: 434 (1952).

The epithet, *hahnii*, has been applied to notomorphs approaching *L. intermedia*.

The results of biosystematic studies on *Lespedeza hirta* × *intermedia* are reported in Clewell (1964b). Fox (1945) claimed that *Hayden 9908* (GH!, TEX!) from Davis Co., Iowa, was probably introduced to the experimental farm on which it was collected.

Lespedeza procumbens × virginica

Lespedeza brittonii Bickn. Torreya **1:** 103 (1901). (T.: *Bicknell s. n.*, Bronxville, Bronx Co., N. Y., 16 Sept. 1893 [NY!]).
Lespedeza procumbens var. *elliptica* Blake, Rhodora **26:** 26 (1924). (T.: *S. F. Blake 8621*, in meadow, Lorton, Fairfax Co., Va. 16 Sept. 1923 [US 1111347!]).

Lespedeza stuevei × virginica

Lespedeza stuevei var. *angustifolia* Britt. Trans. N. Y. Acad. Sci. **12:** 63 (1893) non Pursh 1814. (T.: *J. K. Small & A. A. Heller, s. n.*, Heilig's Mill P. O., Rowan Co., N. C., 13-18 Aug. 1891 [NY!]).
Lespedeza stuevei var. *neglecta* Britt. Mem. Torrey Bot. Club **5:** 206 (1894). (T.: *Small & Heller*, cited above).
Lespedeza neglecta Mackenz. & Bush, Trans. Acad. Sci. St. Louis **12:** 17 (1902).
Lespedeza stuevei f. *angustifolia* M. Hopkins, Rhodora **37:** 265 (1935).
Lespedeza virginica f. *deamii* M. Hopkins, Rhodora **37:** 265 (1935). (T.: *C. C. Deam 55645*, in a wooded sand ridge in the Herschel Green woods about 4 miles north of Washington, Davies Co., Ind., 19 Sept. 1934 [GH!; isotype IND!]).

Britton (1893) described *Lespedeza stuevei* var. *angustifolia* Britt. as having "leaves linear or linear-oblong", not "oval, oblong, or suborbicular" as in typical *L. stuevei*. The following year Britton (1894) renamed such plants as *L. stuevei* var. *neglecta*, possibly because the epithet, *angustifolia*, had been used previously in the genus as *L. angustifolia* (Pursh) Ell. He did not assign types or cite specimens when publishing these names, and no specimens at NY are marked as types of these names. One specimen (*Small* &

Fig. 18. Distribution by county of 6 hybrids.

Heller, Rowan Co., N. C., 1891 (NY!)) bears the following annotations in Britton's hand: *L. stuevei* var. *angustifolia* Britton; *L. stuvei neglecta* Britton; *L. neglecta* (Britton) Mack. & Bush. A second specimen (*Beardslee & Kofoid*, Swain Co., N. C., 1891 (NY!)) Britton annotated as *L. neglecta* Mack. & Bush. Both specimens fit Britton's description of *L. stuevei* var. *angustifolia*, and both are probably *L. stuevei* × *virginica*. I have chosen the *Small & Heller* specimen as the type of these names.

Hopkins (1935) distinguished *L. stuevei* f. *angustifolia* (based on *angustifolia* Britt.) from *L. virginica* f. *deamii* on minute differences in pubescence and lengths of petioles, both being variable characters.

Lespedeza violacea × *virginica*

Lespedeza acuticarpa Mackenz. & Bush, Trans. Acad. Sci. St. Louis **12:** 16 (1902). (T.: *Mackenzie 449*, frequent, limestone barrens at Swope Park, Jackson Co., Mo., 13 Sept. 1901 [MO 148552!]).

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ENVIRONMENTAL CONTROL OF A TAXONOMIC CHARACTER SEPARATING HETEROTHECA S. STR. FROM CHRYSOPSIS

C. JOHN BURK AND CHUNG-HIE NAH

Harms (1965a) recently discussed a diagnostic character, in addition to epappose ray florets, which distinguishes *Heterotheca* s. str. from *Chrysopis*. He noted that in *Chrysopsis* there is a progressive reduction of the petiole length with no enlargement of the petiole bases from the lower to the upper leaves, whereas in *Heterotheca* the sequence from the lower petiolate to the upper sessile leaves is characterized by progressively more expanded petiole bases in successive leaves, resulting in auricles which become increasingly expanded and continuous until they merge with the leaf blade proper, obscuring all traces of the petiole. Hybrids between *Heterotheca latifolia* Buckl. var. *macgregoris* Wagenkn. and *Chrysopis berlandieri* Greene were found to be intermediate in this character (Harms, 1965b).

Several workers have noted a difference in leaf form between spring-collected and fall-collected *Heterotheca* s. str. Benke (1928) described *H. subaxillaris* var. *petiolaris* with leaves which were nearly all petioled except in or near the inflorescence from a plant collected at Galveston, Texas, on March 12, 1928. The petioles were obscurely or not at all dilated at base; the casual aspect of the population from which the type was taken reminded Benke of *Chrysopsis*.

Wagenknecht (1960) noted that, at the southern limits of its range, occasional plants of *H. latifolia* survive mild winters and flower again during the spring and early summer. The spring forms were found to be much shorter than the fall ones, being, in extreme cases, rosette forms with a short, branching inflorescence. The flowers were smaller and all the leaves below the inflorescence were characteristically petiolate and dilated not at all or only slightly at the base.

January-flowering and October-flowering specimens from a population of *H. subaxillaris* (Lam.) Britt. & Rusby which

flowers year-round on Bogue Barrier in North Carolina (Burk, 1961) were recently compared. The January-flowering specimens were found to have markedly larger flowers than specimens collected in flower in October. The lower leaves of the January-flowering specimens were still present, long-petioled, and without auriculate petiole bases except near the inflorescence.

Plants of *Heterotheca* s. str. may be easily propagated by stem cuttings. In a study of morphological variations of clonal plants of *H. subaxillaris*, the seed of which had been obtained from Padre Island, Texas, Nah (1965) showed that the production of leaves with auriculate-clasping petiole bases is photoperiodically determined. Clonal plants were raised for three months under long day (dawn to 10:00 P.M.) and short day (8:00 A.M. to 5:00 P.M.) conditions in the plant house at Smith College. None of the plants flowered during this period; their stems grew, however, well over a foot in height under the experimental regime. The plants on short day developed long-petioled leaves without auriculate petiole bases; the leaves of these plants tended to be larger than those of the long day plants. The stems grew taller on short day and there was no loss of basal leaves. The clonal plants raised on long day developed leaves with well-developed, auriculate-clasping petiole bases; there was a marked loss of basal leaves from the stem of these plants.

The species of *Heterotheca* s. str. are notoriously variable plants which, as several experiments have shown (Burk, 1961; Nah, 1965; Pinson, 1965), produce marked environmentally-induced forms. Valid criteria separating the taxa are difficult to obtain, and a leaf character which separates *Heterotheca* s. str. from the closely allied genus *Chrysopsis* is quite useful. However, as a diagnostic character, it must be used cautiously in identifying plants from areas where flowering on short day lengths might occur naturally or in evaluating *Heterotheca* × *Chrysopsis* hybrids grown on such regimes.

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Vol. 68 October-December No. 776

CONTRIBUTIONS TO THE FLORA OF NOVA SCOTIA VIII. DISTRIBUTION OF ARCTIC-ALPINE AND BOREAL DISJUNCTS[1]

R. W. Hounsell and E. C. Smith

Botanical exploration in Nova Scotia during the past 17 years has revealed a large number of disjunct species of northern affinities. These may be classified as either Arctic-alpine or Boreal disjuncts. Scoggan (1950) classifies arctic species as those whose northern ranges extend beyond the tree line, "including coastal Labrador north of Hamilton Inlet;" both Scoggan's and Fernald's publications (1950) have been consulted in drawing up the present list of species. The boreal species are those whose geographical distribution is confined, generally, to the Northern Conifer Forest. A third group of Nova Scotia disjuncts, containing but three species, may be termed Gulf endemics, i.e, those species found only in isolated localities around the Gulf of St. Lawrence.

Evidence has existed for at least 80 years that such disjuncts in Nova Scotia have two centers of distribution. Lawson (1884) found *Saxifraga Aizoon* Jacq. var. *neogaea* Butters growing in great abundance on the high basalt cliffs of Cape Blomidon, Kings Co. In his catalogue of the

[1]This study was supported in part by the Nova Scotia Research Foundation. Acknowledgement is due also to the many members of the Forest Ecology field crews who, over the years, made most of the collections utilized in this study and to Dr. H. Harries of Mount Allison University for permission to cite his collection of *Luzula spicata*.

Nova Scotian flora Lindsay (1887) listed *Draba norvegica* Gunn. as being found in rock crevices, Big Intervale, Inverness Co. The many new finds of recent years, chiefly made by the junior author and his student field crews from Acadia University, have substantiated these early suggestions of bicentric distribution.

Erskine (1951) recorded *Asplenium viride* Huds. for two new stations, one in Cumberland Co. near the Minas Basin, the other in Inverness Co. in northern Cape Breton. The Nova Scotia distribution for this species is typical of that of many Arctic-alpine and Boreal disjuncts in that it occurs in the Cobequid Hills near Minas Basin and again in the highlands of northern Cape Breton Island. In the region that borders on Minas Basin such species are found on exposed rocky sites of Cumberland, Colchester and Kings counties, less frequently in Hants county and along the Bay of Fundy shoreline into Annapolis and Digby counties. On Cape Breton Island they occupy suitable niches in Inverness and Victoria counties (usually along moist, steep-walled river gorges), much less frequently in Cape Breton and Richmond counties. The region between these two centers, about 170 miles in a direct line, is, apparently, devoid of these species.

Smith and Schofield (1952) added to the growing list of Arctic-montane species recorded for the province. To the inventory of Nova Scotian plants they added *Oxyria digyna* (L.) Hill, *Saxifraga aizoides* L. and others, all found in northern Cape Breton. The very local distribution of these disjuncts was noted by Smith and Erskine (1954); almost every river valley explored in northern Cape Breton harbored a new species, but, in each case, the stations discovered were of very limited size.

Further evidence supporting the concept of two centers of occurrence was provided by Schofield (1955) in his explorations in Cumberland county. He showed that many of the disjunct Arctic-alpine and Boreal species found in rugged habitats of northern Cape Breton are also present in Cumberland county and the near-by Cape Blomidon

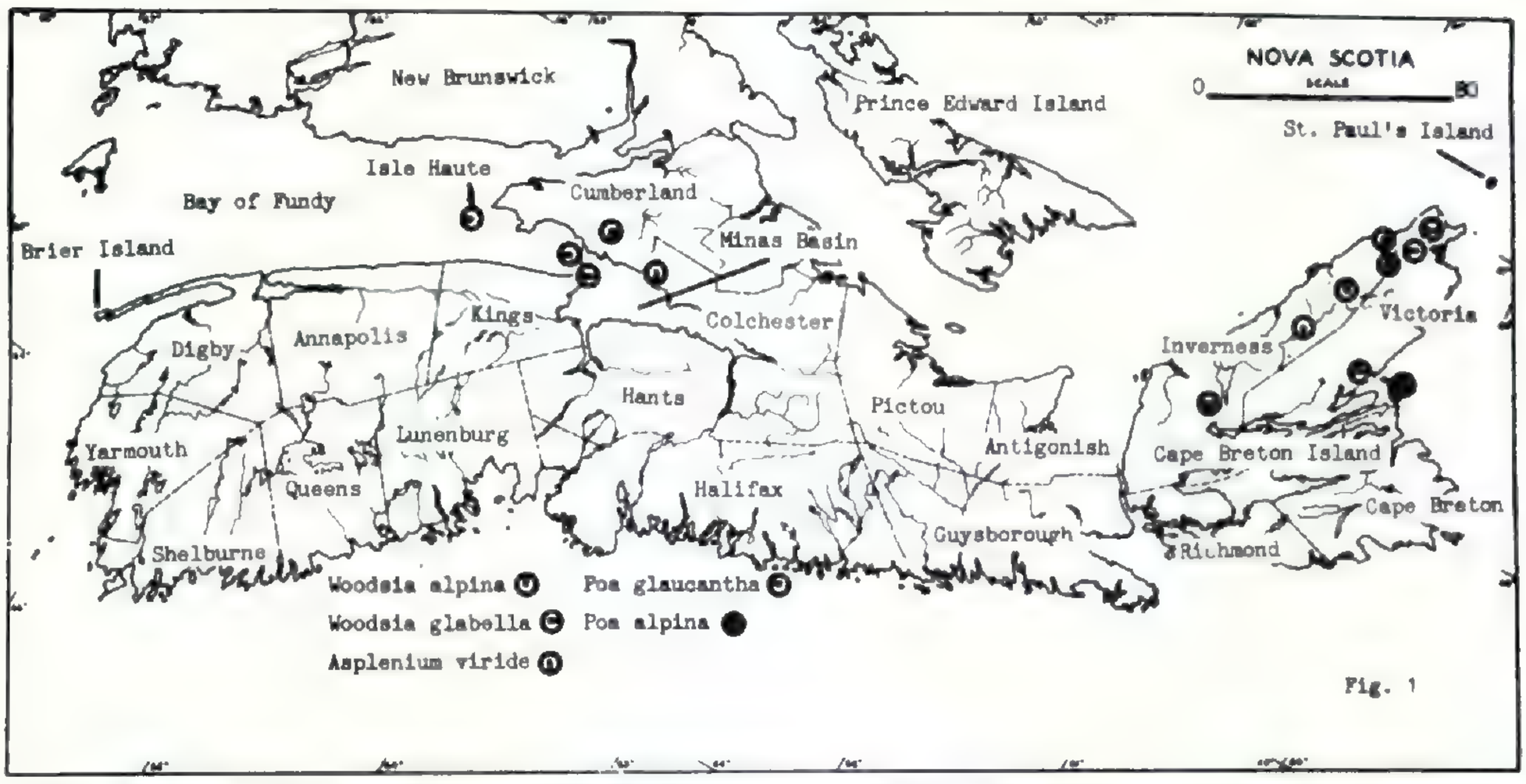

Fig. 1

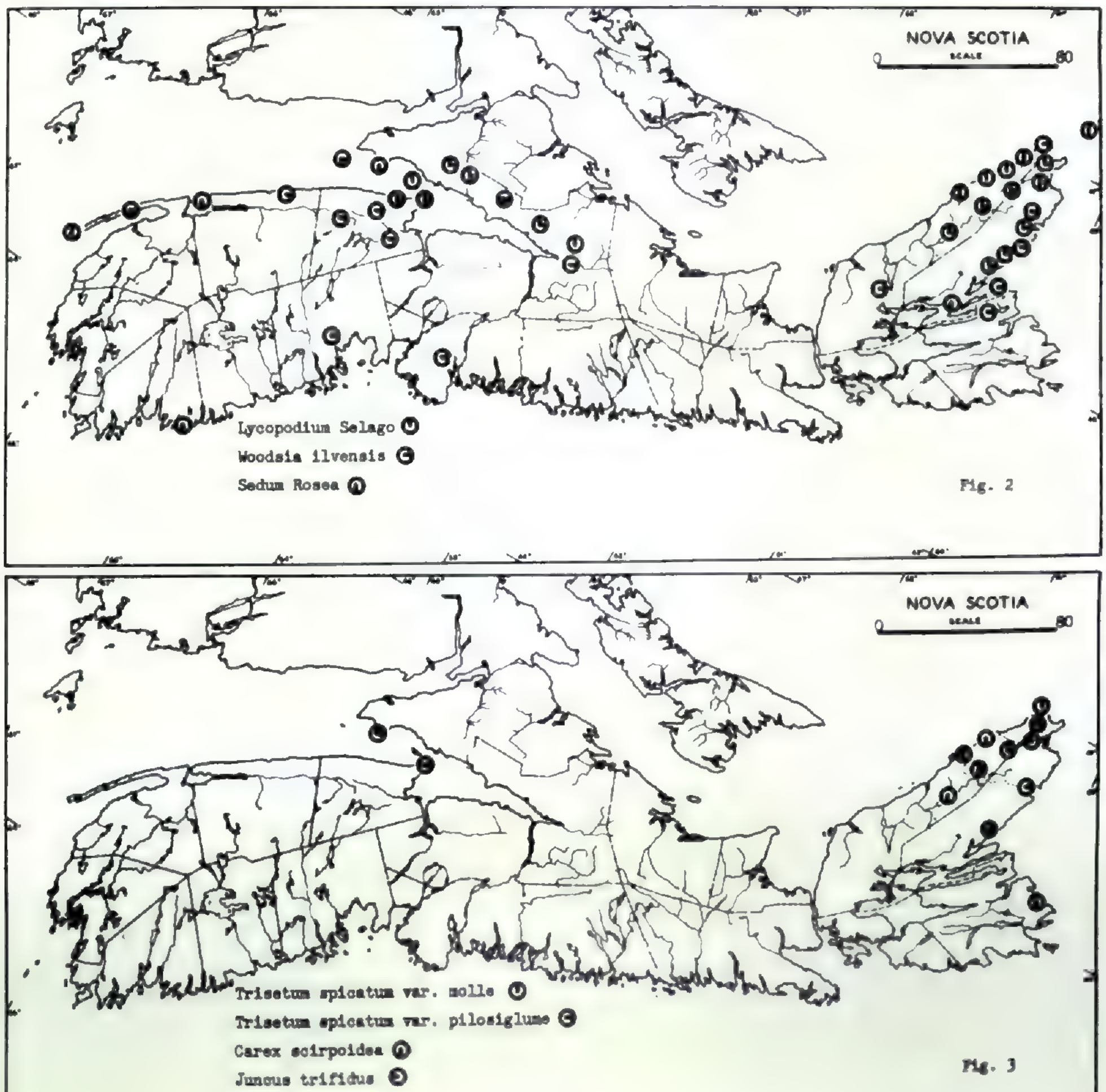

Fig. 2

Fig. 3

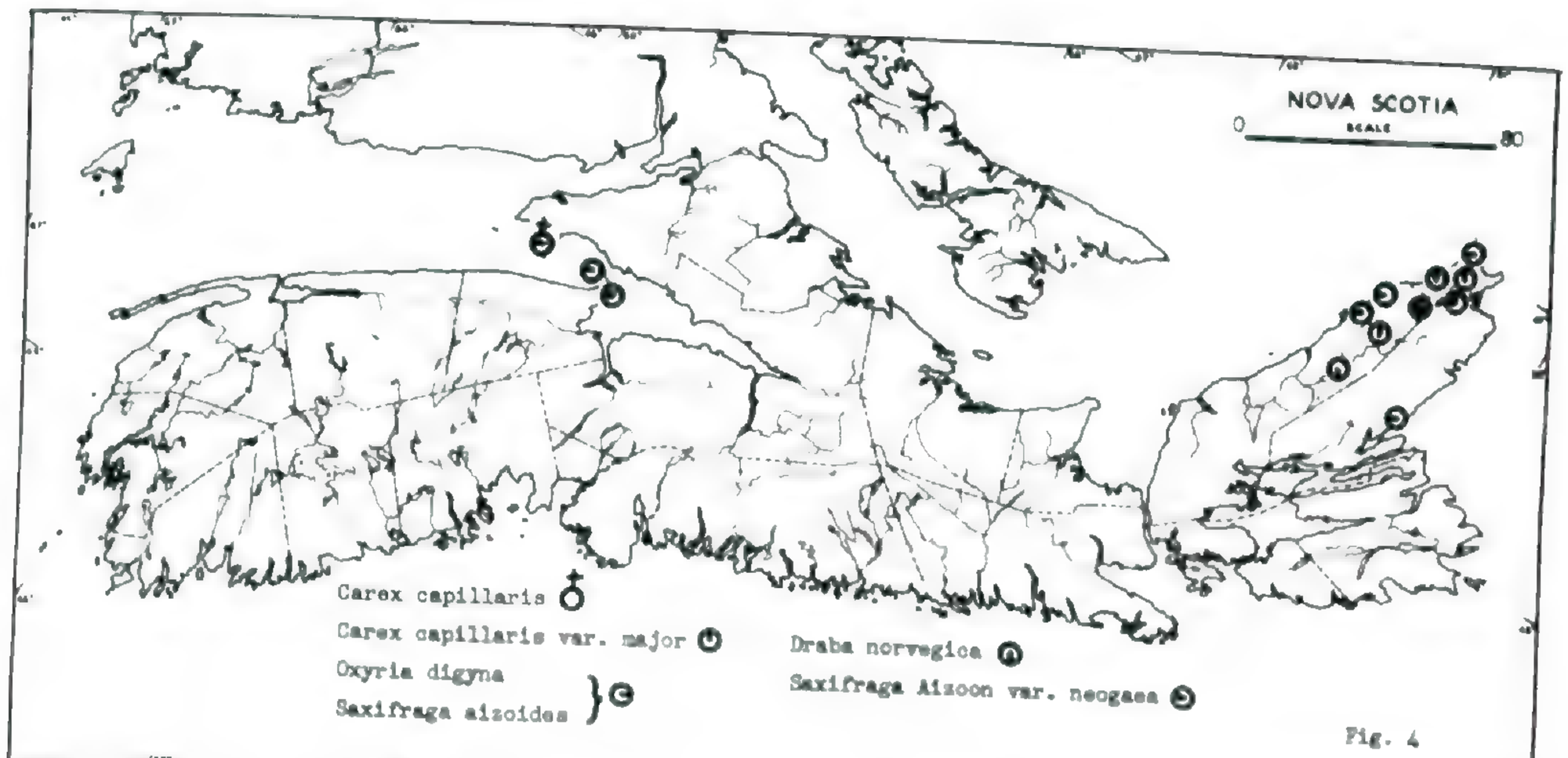

Fig. 4

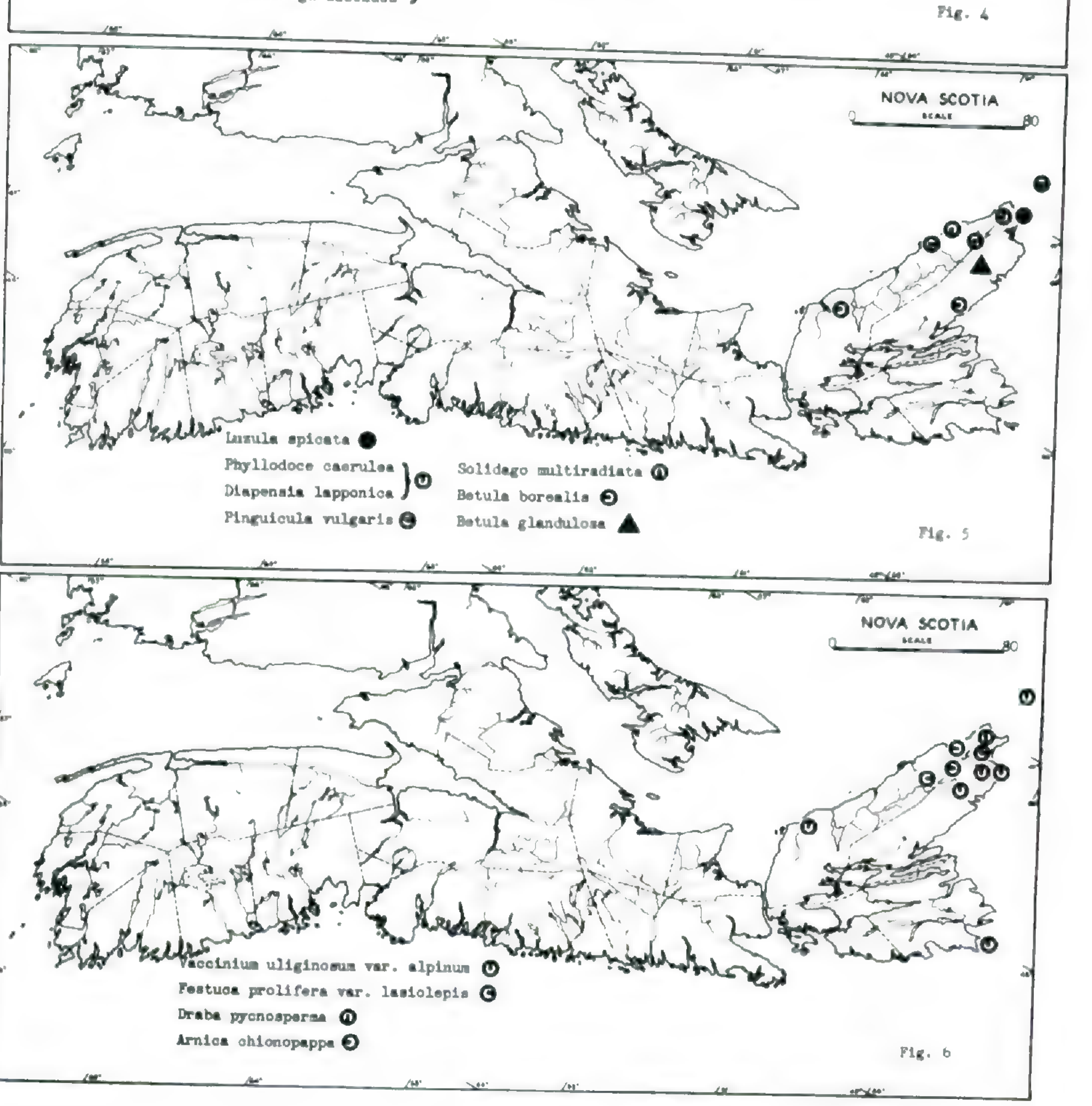

Fig. 5

Fig. 6

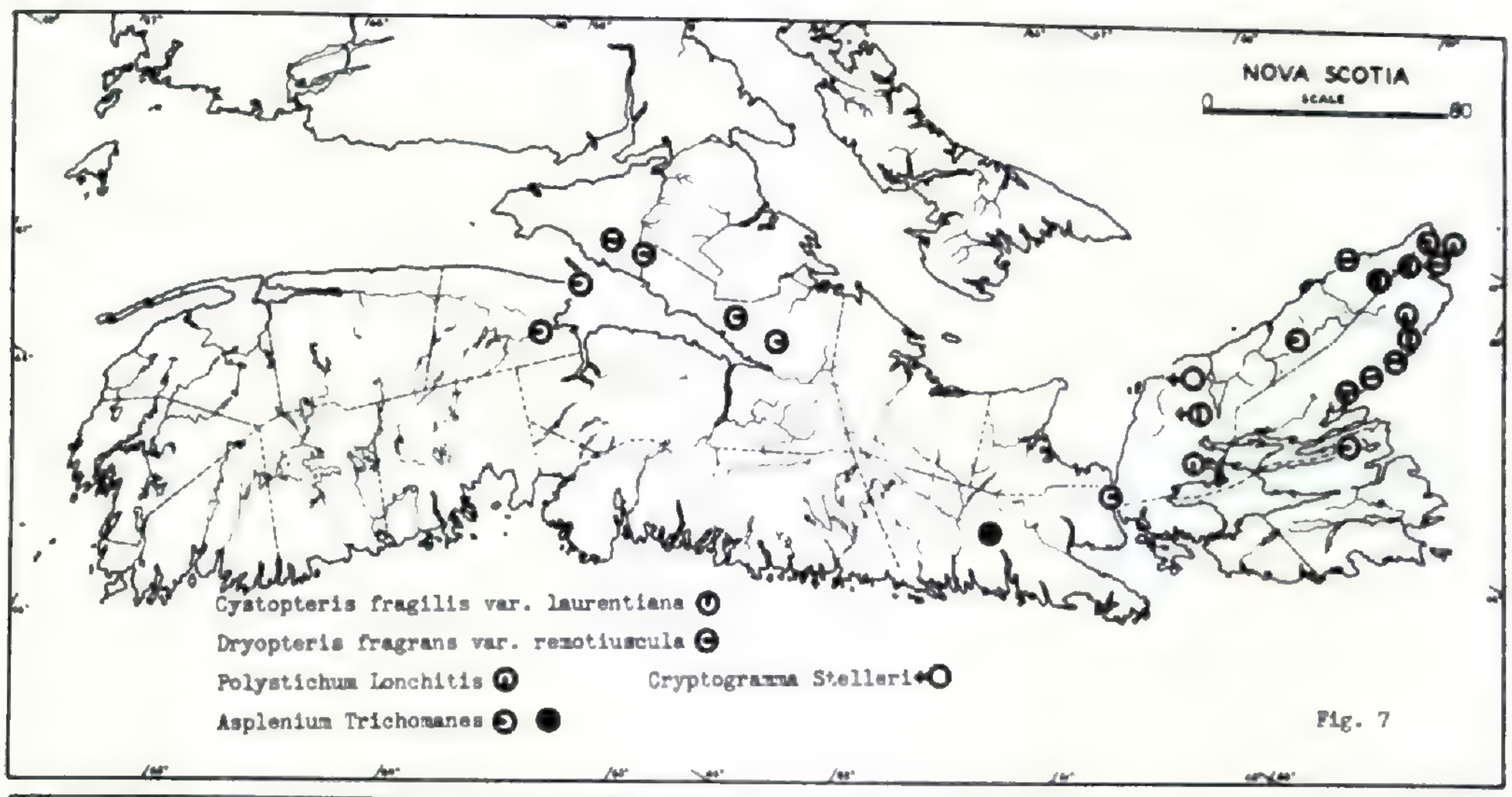

Fig. 7

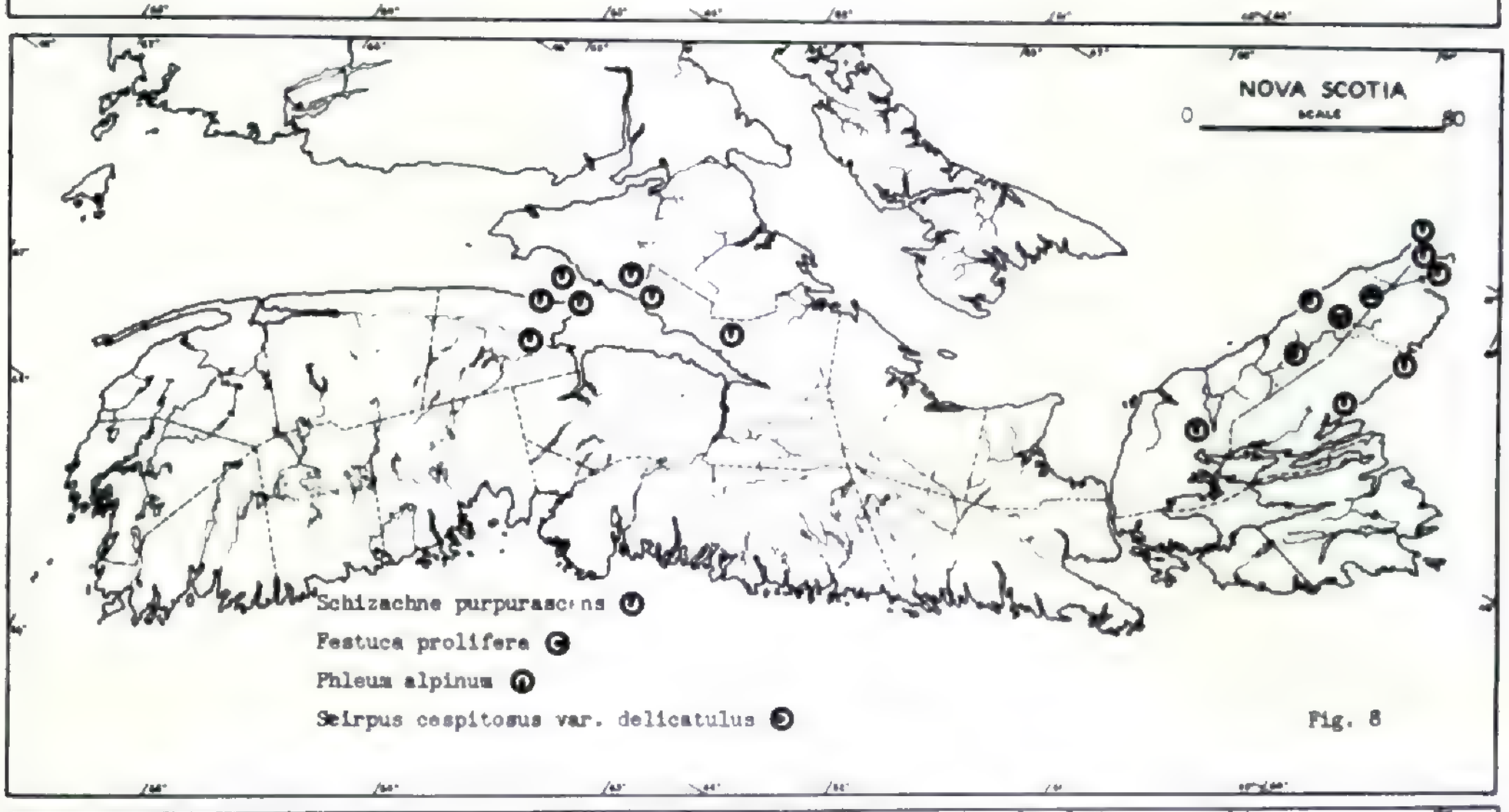

Fig. 8

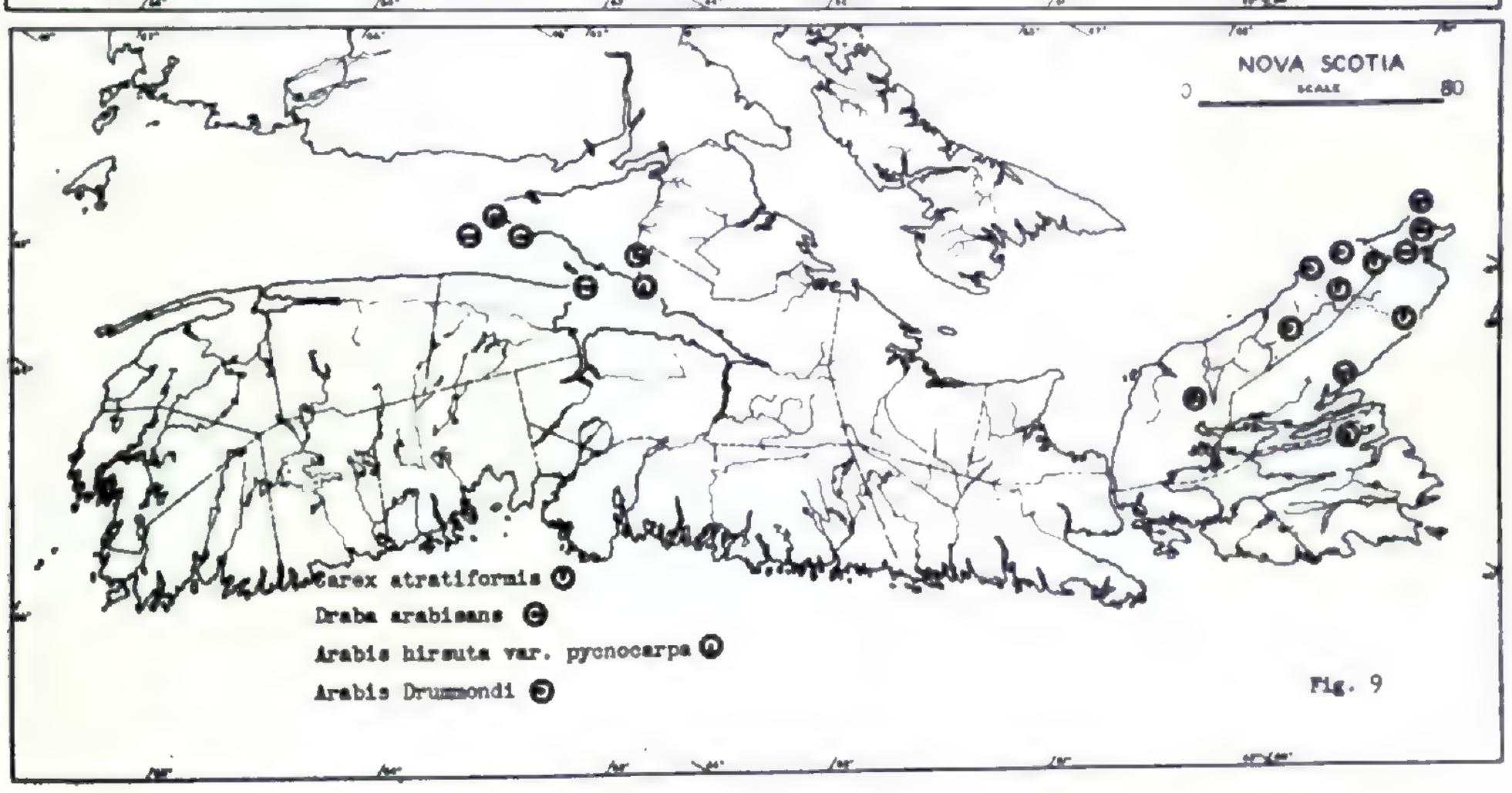

Fig. 9

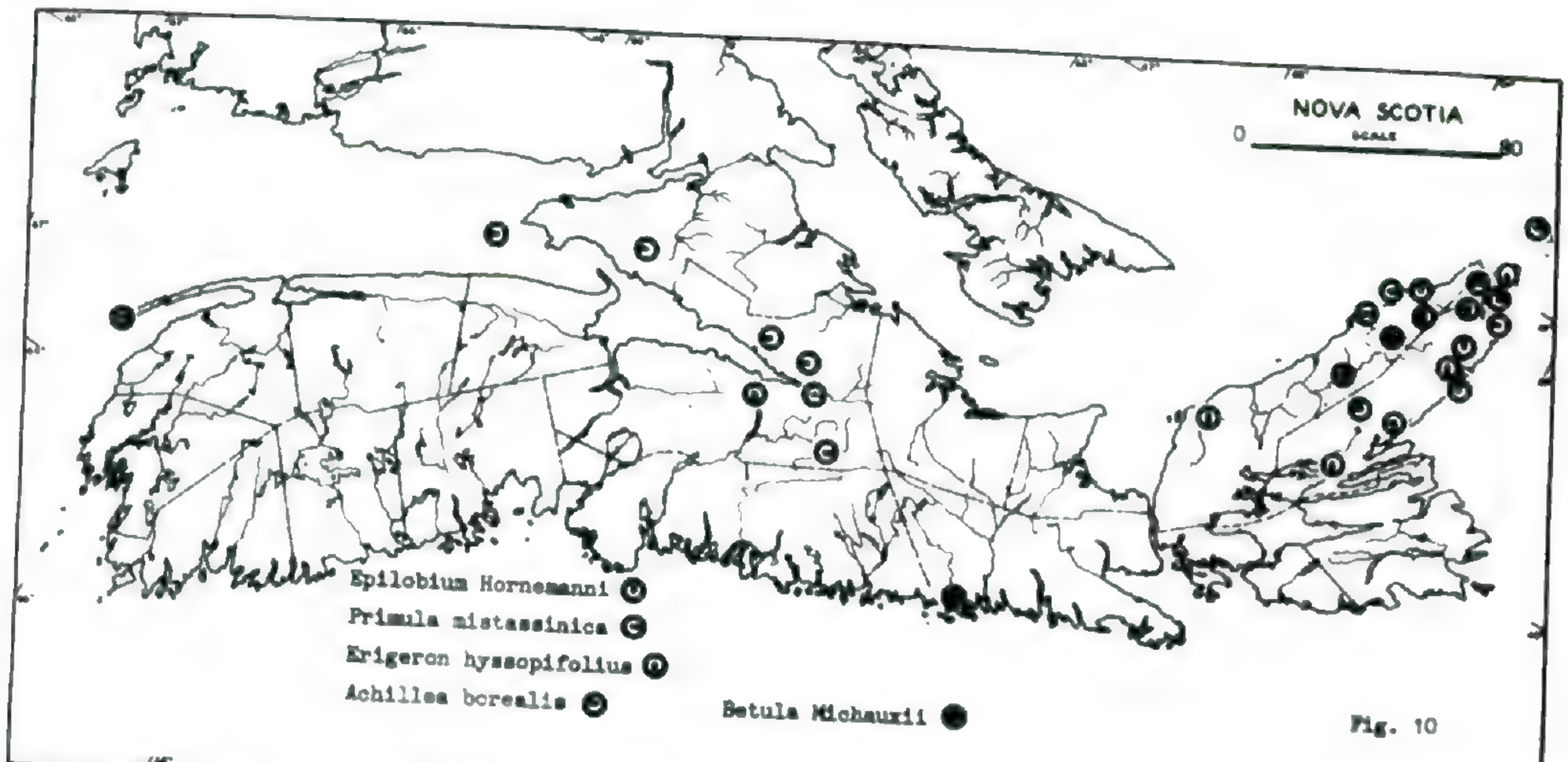

Fig. 10

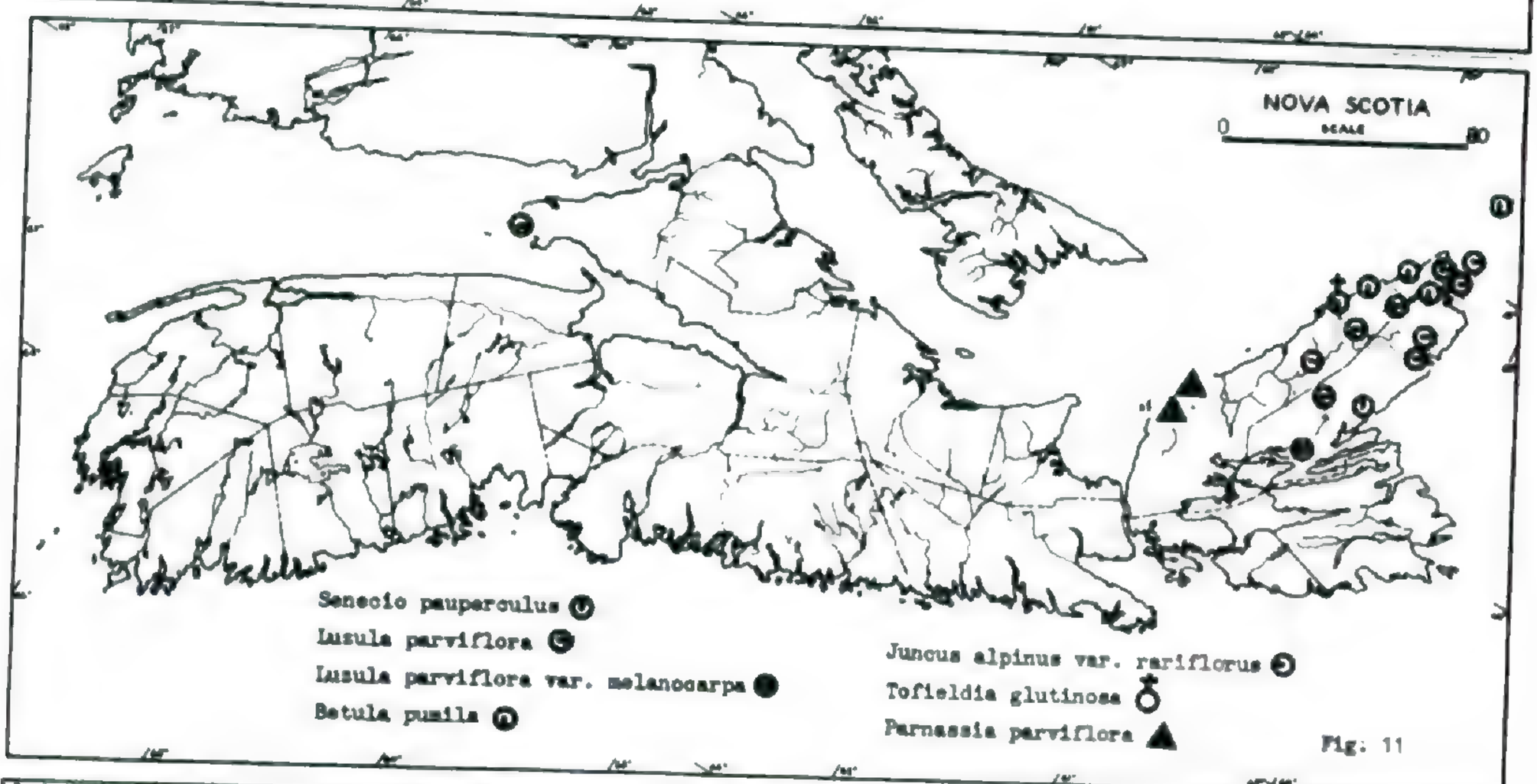

Fig. 11

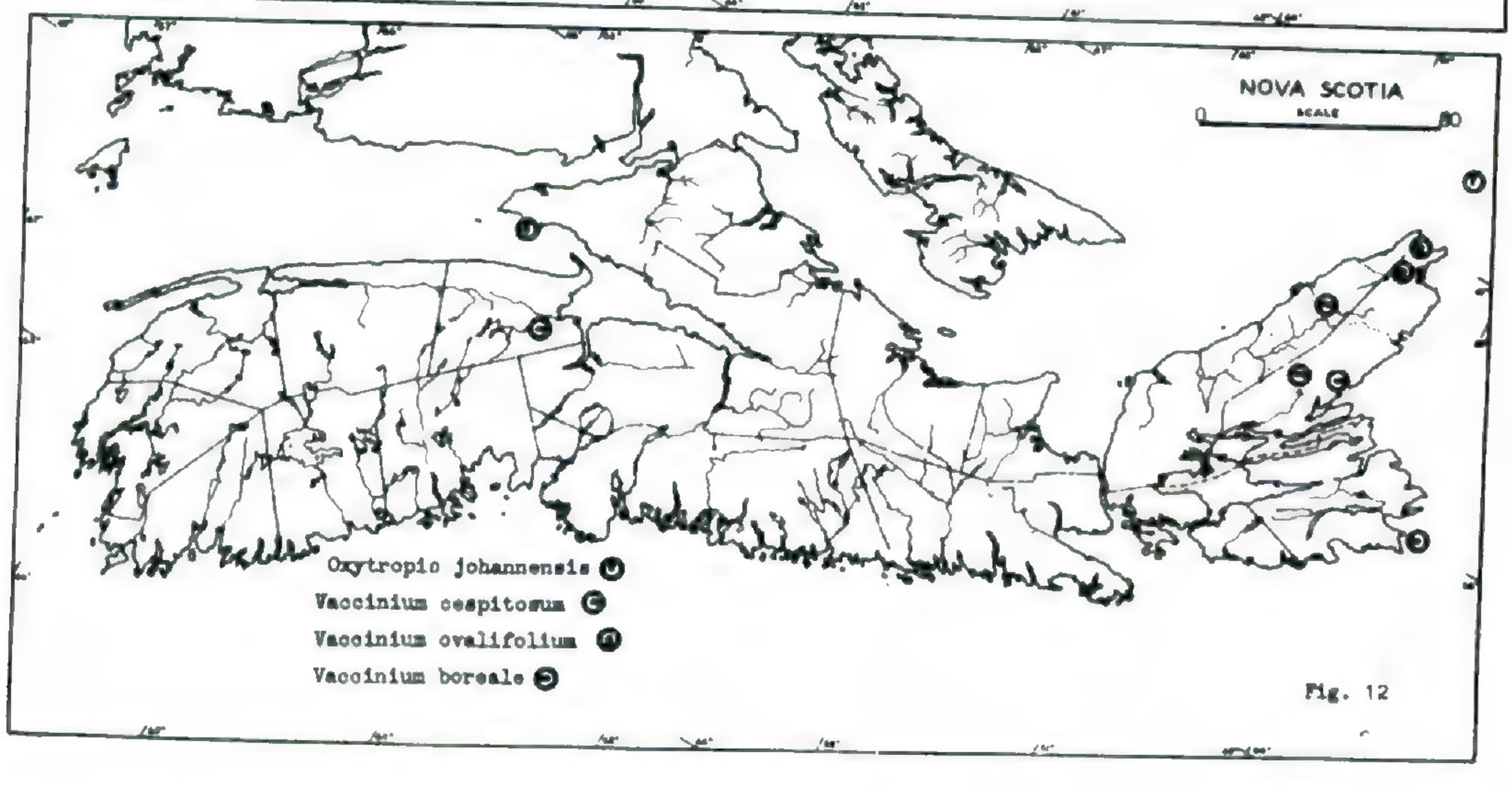

Fig. 12

region of Kings county where they occupy exposed headlands and such similar sites.

The accompanying distribution maps (Figs. 1-12) show the bicentric distribution quite clearly. Each symbol, in most cases, represents several small stations, each of which is separated from the others of its group by distances ranging from a few hundred yards up to five miles; for example, a number of stations found along the cliffs of a river valley are represented here by a single distribution dot.

The counties of Nova Scotia plus other pertinent geographical features are shown in Fig. 1 along with the distribution pattern for five Arctic-alpine species. Of these five species all are found in the northern Cape Breton region (henceforth NCB) whereas three are known from the Minas Basin-Bay of Fundy region (henceforth MB-BF). None are found outside these two areas. When the overall Arctic-alpine picture is assessed one sees that of the 26 species dealt with in this survey (see Table 1, part A) 25 are found in NCB, nine in MB-BF *and* only 2 beyond these two centers. The two found outside these areas (as well as within them) are: *Woodsia ilvensis* (L.) R.Br., from Halifax and Lunenburg counties and *Sedum Rosea* (L.) Scop., which has been collected from Louis Head, Shelburne county. These two widespread Arctic-alpine species plus a third, of perhaps even wider distribution, *Lycopodium Selago* L., are shown in Fig. 2.

Of these 26 species only one, *Carex capillaris* L., has been found in MB-BF but not in NCB.

Most of these Arctic-alpines inhabit river gorge cliffs or exposed outcroppings and headlands but three are plants of the high barrens and bogs: *Betula glandulosa* Michx., *B. borealis* Spach and *Vaccinium uliginosum* L. var. *alpinum* Bigel.

An examination of the distributions of the 32 species classified as Boreal disjuncts and Gulf endemics (Figs. 7-12 and Table 1, part B) reveals that 31 of these are found in NCB, 14 in MB-BF and two only occur in other regions as well. *Asplenium Trichomanes* L. has been reported from

Guysborough Co. by Roland (1947) but since the exact location of the station is not known to the present authors a solid black dot has been placed in the centre of the county (Fig. 7). *Betula Michauxii* Spach grows in Guysborough Co. and on Brier Island, Digby Co. but not in NCB (Fig. 10). Brier Island represents the southwestern extremity of the elevated section of land that lies between the Annap-

TABLE 1

Numbers of Arctic-alpine, Boreal disjunct and Gulf endemic stations in Nova Scotia (NCB — Northern Cape Breton, MB-BF — Minas Basin and Bay of Fundy)

A. Arctic-alpine

Species	NCB	MB-BF	others	total
Lycopodium Selago L.	18	9	—	27
Woodsia ilvensis (L.) R. Br.	19	17	5	41
Woodsia alpina (Bolton) S. F. Gray	5	—	—	5
Woodsia glabella R. Br.	6	1	—	7
Asplenium viride Huds.	6	2	—	8
Poa alpina L.	1	—	—	1
Poa glaucantha Gaudin	5	4	—	9
Trisetum spicatum (L.) Richter var. molle (Michx.) Beal	6	—	—	6
Trisetum spicatum (L.) Richter var. pilosiglume Fern.	7	3	—	10
Carex scirpoidea Michx.	8	—	—	8
Carex capillaris L.	—	1	—	1
Carex capillaris L. var. major Blytt	6	—	—	6
Juncus trifidus L.	3	—	—	3
Luzula spicata (L.) DC.	1	—	—	1
Betula borealis Spach	4	—	—	4
Betula glandulosa Michx.	1	—	—	1
Oxyria digyna (L.) Hill	1	—	—	1
Draba norvegica Gunn	2	—	—	2
Sedum Rosea (L.) Scop.	7	7	5	19
Saxifraga aizoides L.	1	—	—	1
Saxifraga Aizoon Jacq. var. neogaea Butters	6	3	—	9
Phyllodoce caerulea (L.) Bab.	1	—	—	1
Vaccinium uliginosum L. var. alpinum Bigel.	10	—	—	10
Diapensia lapponica L.	1	—	—	1
Pinguicula vulgaris L.	3	—	—	3
Solidago multiradiata Ait.	4	—	—	4
	25/26	9/26	2/26	

B. Boreal Disjuncts, Gulf Endemics(*).

Species	NCB	MB-BF	others	total
Cystopteris fragilis (L.) Bernh. var. laurentiana Weath.	4	—	—	4
Dryopteris fragrans (L.) Schott var. remotiuscula Komarov	5	5	—	10
Polystichum Lonchitis (L.) Roth	13	—	—	13
Asplenium Trichomanes L.	15	3	1	19
Cryptogramma Stelleri (Gmel.) Prantl	2	—	—	2
Schizachne purpurascens (Torr.) Swallen	11	7	—	18
Festuca prolifera (Piper) Fern. var. lasiolepsis Fern.*	3	—	—	3
Phleum alpinum L.	2	—	—	2
Scirpus cespitosus L. var. delicatulus Fern.	3	—	—	3
Carex atratiformis Britt.	5	—	—	5
Juncus alpinus Vill. var. rariflorus Hartm.	10	1	—	11
Luzula parviflora (Ehrh.) Desv.	1	—	—	1
Luzula parviflora (Ehrh.) Desv. var. melanocarpa (Michx.) Buchenau	12	4	—	16
Tofieldia glutinosa (Michx.) Pers.	1	—	—	1
Betula pumila L.	1	—	—	1
Betula Michauxii Spach	8	—	—	8
Draba pycnosperma Fern. & Knowlt.*	—	1	1	2
Draba arabisans Michx.	1	—	—	1
Arabis hirsuta (L.) Scop. var. pycnocarpa (M. Hopkins) Rollins	5	5	—	10
Arabis Drummondi Gray	2	3	—	5
Parnassia parviflora DC.	6	2	—	8
Oxytropis johannensis Fern.	2	—	—	2
Epilobium Hornemanni Reichenb.	1	1	—	2
Vaccinium cespitosum Michx.	12	—	—	12
Vaccinium ovalifolium Sm.	3	1	—	4
Vaccinium boreale Hall & Aalders	2	—	—	2
Primula mistassinica Michx.	3	—	—	3
Erigeron hyssopifolius Michx.	7	2	—	9
Achillea borealis Bong.	10	5	—	15
Arnica chionopappa Fern.*	11	4	—	15
Senecio pauperculus Michx.	2	—	—	2
	2	—	—	2
	31/32	14/32	2/32	
Grand totals	56/58	23/58	4/58	

olis Valley and the Bay of Fundy. This elevated area, known as North Mountain, is about 500 feet high at Cape Blomidon at the Minas Basin end but becomes lower to the southwest so that at Brier Island the land is low, flat and boggy.

Combining the Arctic-alpine and Boreal disjunct figures one sees that of the 58 species 56 have been collected in NCB but only 23 in MB-BF. This fact can be correlated with the greater number of suitable habitats in NCB, particularly damp, cool cliffs along the many river valleys and gorges. A following paper will present descriptions of these cliff-face stations, discussing the ecological implications.

The following collections, used in this study, have not been reported previously:

Poa alpina L. Cliff top, Ciboux Island, Victoria Co., *Smith et al. 10958*. First collection for province.

Luzula spicata (L.) DC. Headlands at 1000 feet near Bay St. Lawrence, Victoria Co., *H. Harries, 804*. First collection for province.

Pinguicula vulgaris L. Rare on moist ledges in sphagnum, cliff near mouth of Cheticamp River, Inverness Co., *D. H. Webster, 626*. Two plants in small crevices at river edge, Big Southwest Brook, Inverness Co., *Smith*, *Pick* and *Hounsell, 22134*. This species had previously been collected only from St. Paul's Island by *Perry* and *Roscoe, 352*, in 1929.

Arnica chionopappa Fern. The collection from cliff ledges, Big Southwest Brook, *Smith, et al. 6503*, represents a second station for the province.

The distribution maps were compiled from collections deposited in the Herbarium of Acadia University. Additional distributional information was obtained from Roland (1947).

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SOME ADDITIONS AND CORRECTIONS TO THE FLORA OF TEXAS — III

DONOVAN S. CORRELL

Additional data regarding the flora of Texas contained in this paper have been uncovered in the course of my work on a Manual of the vascular plants of Texas with Marshall C. Johnston. This project is being supported, in part, by a grant from National Science Foundation (GB-2409). All of the specimens cited, unless otherwise noted, are in the Lundell Herbarium (LL) of Texas Research Foundation. I wish to acknowledge the help of my wife and colleague, Dr. Helen B. Correll, in the preparation of this paper.

Erythronium americanum Ker, Bot. **Mag.**, *Pl. 1113*. 1808.

TEXAS: Sabine County, abundant in the woods at Patroon Creek, campground about 10 miles north of Milam, flowers yellow, outer petals red-brown on the lower surface, [no date], *Betty E. Lemmon 830*. San Augustine County, rich hardwoods, 7 miles east of San Augustine, east of Apolo-gacho stream, Cousins' farm, black ankle community, March 17, 1962, *D. S. Correll & Helen B. Correll 24829*.

As far as we know, this species is new to Texas. It has previously been reported to occur only as far southwest as Arkansas and Oklahoma. It differs from *A. albidum* Nutt. var. *mesochoreum* (Knerr) Rickett, east- and north-central Texas, in having yellowish instead of pinkish or bluish white flowers.

Triphora trianthophora (Sw.) Rydb. var. **Schaffneri** Camp, Rhodora **42**: 55-56. 1940.

TEXAS: Smith County, low woods about 1 mile east of Hopewell Baptist Church at Swan, in clumps of 100 or more plants scattered, plants up to 3 dm. high, stems reddish purple, capsule erect, flowers pink, readily deciduous, October 20, 1965, *D. S. Correll & Helen B. Correll 32034*.

This distinctive variant, distinguished from var, *trianthophora* by its smaller flowers and erect, not pendent, fruits, is exceedingly abundant in a large tract of virgin forest in the above-cited locality in Texas. It is new to the flora of the state.

Emex spinosa (L.) Campd., Mon. Rum. 58, *tab. 1, fig. 1.* 1819.
TEXAS: Kleberg County, in sandy loam, old school ground, Riviera, flowers white, March 10, 1966, *John R. Crutchfield 1090.*

This Mediterranean species has become introduced in various parts of the world. As far as we know, this is the first collection from Texas.

Sesuvium erectum Correll, sp. nov.

Herba perennis, typica erecta vel recto-patens, cum globulis crystallinis plus minusve velata, fusca vel fumea in siccitate; caules ad 5 dm. vel magis longi; folia oblanceolata vel spathulata vel aliquando delineari-oblonga, ad apicem obtusa, infra in basem amplectentem decrescentia; flores plurimi, e foliorum et ramorum axillis orti, sessiles vel pedicellis ad 5 mm. longis; lobi calycis late elliptici vel ovato-lanceolati, ad apicem obtusi vel subacuti, intra roseo-violacei, appendice subapicali dorsali apicem sepali aequanti vel superanti; styli 3 ad 5, comspicui, typice atri ubi exsiccati; stamina plurima; capsula ovoidea, ad apicem obtusa et truncata; semina turgida, atra, circa 1 mm. longa.

Plants perennial, typically erect to erect-spreading or sometimes decumbent, more or less adorned throughout with crystalline globules, when dry brownish black to dark gray; stems up to 5 dm. or more long; leaves oblanceolate to spatulate or sometimes linear-oblong, obtuse at apex, tapered below to a clasping base, up to 4 cm. long and 8 mm. wide; flowers numerous, in the axils of leaves and branches, sessile or with pedicels rarely up to 5 mm. long; calyx-lobes broadly elliptic to ovate-lanceolate, obtuse to subacute at apex, rose-purple within, 4-8 mm. long, with a subapical dorsal appendage about equal to or greatly exceeding the sepal-apex; styles 3 to 5, conspicuous, typically black when dry; stamens numerous; capsule ovoid, blunt and truncate at apex, about 5 mm. long and 3 mm. in diameter; seeds black, plump, about 1 mm. long.

TEXAS: Kenedy County, edge of pond, 25 miles south of Sarita, along U. S. rte. 77, July 12, 1957, *D. S. Correll & I. M. Johnston 17868* (holotype, LL). Brooks County, in depression among sand hills near gypsum quarry, several miles southeast of Falfurrias, plant erect (only one plant seen), July 10, 1957, *D. S. Correll & I. M. Johnston 17825* (paratype, LL).

According to our interpretation of the complex genus *Sesuvium*, there are six species in Texas. One of these, *S. verrucosum* Raf., is found in the interior of west and northwest Texas, and, of special interest, when dry the plants are usually a light brown or tan-color. The other five taxa are essentially coastal with the exception of *S. erectum* which occurs northwestward along the Rio Grande into Trans-

Pecos, Texas. Interestingly, all of these coastal plants, except *S. trianthemoides*, are dark gray or nearly black when dry. Of these taxa, *S. trianthemoides* and *S. maritimum* (Walt.) B.S.P., with their 5-staminate flowers, and *S. Portulacastrum* L., with its large, long-pediceled flowers, are quite distinctive. A small intricate plant, typically of coastal clay dunes and flats, which has sessile, narrowly linear-oblong leaves and is densely covered with crystalline globules, is referred to *S. sessile* Pers. The remaining robust, erect to erect-spreading, typically more inland, plants are referred to *S. erectum*.

Sesuvium trianthemoides Correll, sp. nov.

Herba annua, succulenta, fulva in siccitate, basiramifera, cum globulis dispersis crystallinis grandibus; caules ad 3.5 dm. vel magis longi, internodiis 4-5 cm. longis; folia opposita, oblanceolata vel spathulata, ad apicem obtusa, minimum 3 cm. longa (petiolo incluso) et 1 cm. lata supra medium, infra in petiolum conspicuum attenuata; petiolus basi late scarioso-alatus et amplectens; flores solitarii, sessiles, e foliorum et ramorum axillis orti; lobi calycis triangulo-ovati, ad apicem subacuti, valde nervati, circa 3.5 mm. longi, margine hyalino, appendice apicali dorsali parva; stamina 5, filamentis gracilibus circa 1 mm. longis; ovarium ovoideum bicellulare; styli 2, circa 0.5 mm. longi; capsula ovoideo-ellipsoidea ad apicem acuta, 4-5 mm. longa, circumscissilis; semina circa 10 in quaque capsula, circa 1.5 mm. longa, conspicue rugosa cristis irregularibus ferrugineis granularibus, plagis gilvis in ambitu vagis e hilo extensis.

Plant annual, fleshy, brown when dry, branched from the base, the herbage with scattered large crystalline globules; stems up to 3.5 dm. long or more, the internodes 4-5 cm. long; leaves opposite, oblanceolate to spatulate, obtuse at apex, at least 3 cm. long (including the petiole) and 1 cm. wide above the middle, tapered below into a conspicuous petiole; petiole broadly scarious-winged at base and clasping; flowers solitary in the axils of leaves and branches, sessile; calyx-lobes triangular-ovate, subacute at apex, strongly nerved, about 3.5 mm. long, with hyaline margins, the dorsal apical appendage small; stamens 5, with slender filaments about 1 mm. long; ovary ovoid, 2-celled; styles 2, about 0.5 mm. long; capsule ovoid-ellipsoid, pointed at apex, 4-5 mm. long, circumscissile; seeds about 10 in each capsule, about 1.5 mm. long, conspicuously rugose with brownish granular irregular ridges, with additional light patches extended in irregular lines from the hilum.

TEXAS: Kenedy County, dunes, July 11, 1947, *B. C. Tharp 47431* (holotype, TEX).

Similarly to *S. maritimum*, the flowers of this species

have only 5 stamens. However, the conspicuously rugose, not smooth, seeds readily set it apart from that species. Also, as its name implies, it resembles very closely in habit and appearance the rather common *Trianthema Portulacastrum* L. Oddly enough, its rugose seeds also resemble those of *Trianthema*.

Paronychia Jamesii T. & G. var. **praelongifolia** Correll, var. nov.

Varietate *Jamesii* similis, sed foliis calycem superantibus.

Similar to var. *Jamesii* but with leaves exceeding the calyx.

TEXAS: Brewster County, North Sunny Glenn, July 17, 1938, *O. E. Sperry T683* (TAES); top of Old Baldy Mt., June 18, 1941, *B. H. Warnock 20355*. Childress County, Childress, May 1930, *Biol. Class 18* (TEX). Crockett County, infrequent perennial, limestone soil, 15 miles north of Juno, alt. 1500 ft., June 7, 1957, *B. H. Warnock & W. D. McBryde 15191*. Culberson County, off highway U. S. 62, limestone foothills of Guadalupe Mountains, entrance to Guadalupe, perennial herb, August 8, 1945, *C. L. Lundell & Amelia A. Lundell 14374* (holotype, LL); Beach Mts., 8 miles north of Van Horn, frequent on slopes and summit, June 3, 1938, *H. C. Cutler 29644* (TAES). El Paso County, crevices of igneous rock, west slope of Franklin Mts., east of Canutillo, July 4, 1958, *D. S. Correll & I. M. Johnston 19245*. Howard County, Big Spring, May 24, 1945, *V. L. Cory 49279*. Potter County, along a small stream, 10 miles north of the Canadian River on Hy. #87, flowers yellow, June 2, 1957, *D. S. Correll 16616*. Taylor County, 18 miles southwest of View, May 27, 1943, *W. L. Tolstead 7302* (TEX); San Angelo, common on gravelly arid soil, May 19, 1899, *W. L. Bray 359* (TEX). Wilbarger County, 3-3/4 miles south of Vernon, May 12, 1934, *H. B. Parks & V. L. Cory 13179* (TAES).

The calyx of var. *Jamesii* usually exceeds or is equal to the subtending leaves, but the calyx of var. *praelongifolia* is exceeded by the leaves, often conspicuously so, and the plants are found mainly in west and northwest Texas.

Cuphea carthagenensis (Jacq.) Macbr., Field Mus. Pub., Bot. 8: 124. 1930.

TEXAS: Hardin County, 4.5 miles north of Sour Lake, forming a large colony on edge of low wet woods, flowers pink, October 10, 1965, *D. S. Correll 31987*.

This species, which has been known from North Carolina and Louisiana, is new to Texas. It is quite different from *C. petiolata* (L.) Koehne that occurs from Oklahoma northeastward in its sparsely hispid stems and branches, flowers half the size of that species and its much-abbreviated, gla-

brous style in contrast to the long, pubescent style of *C. petiolata*.

Frankenia Johnstonii Correll, sp. nov.

Frutex ad 3 dm. altus, basi lignea a radicibus fuscis filo metallico similibus sustinenti et caules plures vel multos elongatos arcuatos vel valde recurvatos emittenti; planta omnis cana vel glaucescens; caules subherbacei, circa 1 mm. lati, sparsim pilosi, pilis brevibus albidis appressis vel incurvatis; internodia vulgo 1-1.5 cm. longa; folia opposita, certe petiolata, oblanceolata vel oblongo-elliptica, ad basim rotundata, ad apicem rotundatum minute apiculata, ad 13 mm. longa et 4 mm. lata, margine revoluto, supra pilosis appressis sparsim brevipilosa, infra sparsim farinosa et incana; petioli flavovirentes, 1-2 mm. longi, leviter alati, alis pubescentibus membranaceis circum nodum conjunctis; flores sessiles, solitarii, ad apicem ramulorum axillarium; calycis tubus valde costatus, circa 4 mm. longus, 5 lobis triangularibus circa 2 mm. longis; petala 5, unguiculata, alba elliptico-oblanceolata, ad apicem erosa, calyce duplo longiora; stamina 6, inclusa longitudine varia; styli 3-fissi.

Shrub up to 3 dm. high, the woody base supported by dark brown wiry roots and giving rise to several or many elongated arching or strongly recurved willowy stems, the entire plant grayish or bluish green; stems subherbaceous, about 1 mm. thick, sparsely pilose with short whitish appressed or incurved hairs; internodes mostly 1-1.5 cm. long; leaves opposite, distinctly petioled, oblanceolate to oblong-elliptic, rounded at base, minutely apiculate at the rounded apex, up to 13 mm. long and 4 mm. wide, the margins somewhat revolute, the upper surface sparsely short-pilose with appressed hairs, the lower surface farinaceous and hoary; petioles brownish-green, 1-2 mm. long, slightly winged with the membranous pubescent wings united around the node; flowers sessile and solitary at the apex of short axillary branchlets; calyx-tube strongly ribbed, about 4 mm. long, the 5 triangular lobes about 2 mm. long; petals 5, clawed, white, elliptic-oblanceolate, erose at the apex, about twice as long as the calyx; stamens 6, of various lengths, included; styles 3-cleft.

TEXAS: Zapata County, rocky hillside 24.5 miles northeast of San Ygnacio on road to Aguilares, small shrub up to 1 foot high, flowers white, March 16, 1966, *D. S. Correll 32254* (holotype, LL; isotypes, UC, GH, TEX, US). Starr County, on salt flats along Arroyo Los Olmos just east of El Sauz, spreading shrub 1 foot high, flowers white, March 17, 1966, *D. S. Correll 32308* (paratypes, DS, K, LL, S).

This species is characterized by its elongated, strongly recurved stems with long internodes, and distinctly petioled leaves that are farinaceous on their lower surface. These characteristics readily distinguish it from the other four species found in the United States and northern Mexico.

It is a pleasure to name this distinctive species for my friend and colleague, Marshall C. Johnston, who kindly directed my attention to its uniqueness.

Myriophyllum verticillatum L., Sp. Pl. 992. 1753.

TEXAS: Bowie County, attached and floating in Club Lake about 3 miles west of New Boston, May 12, 1962, *D. S. Correll & E. C. Ogden 25243*. Harrison County, Crip's Camp, east of Uncertain, floating on Caddo Lake, May 10, 1962, *D. S. Correll & E. C. Ogden 25213*. Henderson County, in water at head of Big Lake (Preserve), Koon Kreek Klub, off rte. 19, 12 miles south of Athens, May 5, 1965, *D. S. Correll, Helen B. Correll & John R. Crutchfield 30938*. Rusk County, in water of Lake Cherokee, near Monroe off rte. 322 from Longview to Henderson, June 3, 1965, *D. S. Correll & Helen B. Correll 31094*. Indefinite: "Texas," *E. Dapprich 7577* (SMU).

This species is new to Texas. It is readily distinguished from *M. heterophyllum* Michx., which it superficially resembles, by having its floral bracts pinnately dissected or lobed instead of being entire or only merely toothed.

Limonium limbatum Small var. glabrescens Correll, var. nov.

Ramuli ultimi inflorescentiae elongati et aliquantum laxi; calycis costae glabrae vel pilis non nisi paucis sparsis.

Ultimate branchlets of the inflorescence elongated and rather laxly flowered; calyx-ribs glabrous or with only a few scattered hairs.

TEXAS: Reeves County, in saline soils just north of Pecos, flowers nearly white, July 27, 1957, *D. S. Correll & I. M. Johnston 18564* (holotype, LL).

The ultimate branchlets of the inflorescence in var. *glabrescens* are somewhat elongated and more laxly flowered than in var. *limbatum* whose flowers are borne in dense abbreviated clusters. The calyx-ribs of var. *glabrescens* are also glabrous or are provided with only a few scattered hairs instead of being densely pubescent as in var. *limbatum*.

Scrophularia marilandica L., Sp. Pl. 619 1753.

TEXAS: Red River County, down Red River from Hy. 39 [37], first collection in Texas, August 25, 1948, *H. B. Parks s. n.*; On river terraces in open woods along the Red River above bridge, just west of Rte. 37, north of Negley, plants up to 7 ft. high, August 29, 1966, *D. S. Correll 33564*.

This species has apparently never been reported from Texas. It was first collected by Parks too late to include in his and Cory's *Catalogue of the Flora of Texas* (Texas Agr. Exp. Sta. Bull. 550: 1937). Also, for some unknown reason,

it was not included in Cory's unpublished revision copies of the *Catalogue*. It was also omitted from Gould's *Texas Plants*, published in 1962.

Proboscidea sabulosa Correll, sp. nov. (Plate 1335)

Herba annua, procumbens et ramosissima, ad circa 12 dm. lata et 4 dm. alta, omnino viscido-pubescens; folia petiolis incrassatis ad 10 cm. vel magis longis, triangulo-ovata vel late subreniformia, late cordata, apice rotundata vel obtusa, margine undulato-repando, ad circa 12 cm. longa et lata; flores plures, in racemo congesto super pedunculo abbreviato prodientes; inflorescentia folia brevior; pedicelli per anthesin graciles circa 1 cm. longi, maturitate crassi circa 2 cm. longi; bracteae 2, oblongo-ellipticae, 7-8 mm. longae; calyx 1-1.3 cm. longus, supra medium irregulatim 5-lobatus, ad basim ventraliter fissus; corolla tubulari-cylindracea, non nisi leviter ventricosa; corollae tubus extra cremeus et sparsim glandulosus, circa 2 cm. longus, orificio 1 cm. lato; faux glabra, cremea, maculis parvis rubiginosis et linea crocea pro longitudine tubi facie inferiore extensa; corollae lobi 5, ovati vel aliquantum quadrati, violacei, 4-5 mm. longi, recurvati, lobo infimo plicato; capsulae corpus oblongo-ellipsoideum, aliquantum laterale complanatum, endocarpio grosse sculpto, pagina dorsali carinatum, circa 7 cm. longum et 1.5-2 cm. latum, in cornu gracile recurvatum, longitudine corporis duplo longius protractum.

Plant annual, sprawling and much-branched, up to about 12 dm. across and 4 dm. high, the herbage viscid-pubescent throughout; leaves with thickened petioles up to 10 cm. long or more, triangular-ovate to broadly subreniform, broadly cordate, rounded to obtuse at apex, the margins undulate-repand, up to about 12 cm. long and broad; flowers several, borne in a congested raceme on an abbreviated peduncle, greatly exceeded by the foliage; pedicels slender and about 1 cm. long in flower, becoming stout and about 2 cm. long in fruit; bracts 2, oblong-elliptic, 7-8 mm. long; calyx 1-1.3 cm. long, irregularly 5-lobed above the middle, ventrally split to the base; corolla tubular-cylindric, only slightly ventricose; corolla-tube cream-color and sparsely glandular without, about 2 cm. long and 1 cm. across the orifice, the glabrous throat cream-color with small reddish spots and a deep yellow line running the length of the tube on the lower side; corolla-lobes 5, ovate to somewhat quadrate, purplish red, 4-5 mm. long, recurved, the lower lobe pleated; fruit-body oblong-ellipsoid, somewhat laterally compressed, the endocarp coarsely sculptured, keeled on the dorsal surface, about 7 cm. long and 1.5-2 cm. thick, tapered into a slender recurved horn that is about twice as long as the body.

Texas: Crane County, on shinnery oak dunes along Ranch Road #1233 about 1.5 miles west of U. S. Rte. 385, north of Crane, August 6, 1966, *D. S. Correll 33328* (holotype, LL, isotypes, GH, TEX, UC, US);

Plate 1335

PROBOSCIDEA SABULOSA Correll: Upper, fruits, about × 1/3; lower, portion of plant, note tiny flower in center of picture, about × 2, from Crane Co., Texas, *Correll*, no. 33328.

in deep sand of dunes 11 miles northwest of Crane on Ranch Road #1601 to Penwell, August 6, 1966, *D. S. Correll 33332* (paratype, LL).

This is apparently the smallest flowered species in this genus. The abbreviated inflorescences are concealed by the foliage and it is necessary to search the plant in order to locate flowers. Because of its exceeding abundance in the dunes where it occurs in Crane County it is most unusual that this species has not come to light before now.

Utricularia juncea Vahl, Enum. Pl. 1: 202. 1804.

TEXAS: Angelina County, along marshy edge of brook, in pine land, off U. S. 63, near Beans Place, northwest of Jasper, September 8, 1942, *C. L. Lundell 11797*; boggy stream, 3 miles west of Bouton Lake, Angelina National Forest, June 6, 1963, *D. S. Correll & D. C. Wasshausen 27522*. Henderson County, on mud, boggy area above Withers Lake, Koon Kreek Klub, off Rte. 19, 12 miles south of Athens, May 5, 1965, *D. S. Correll, Helen B. Correll & John R. Crutchfield 30945*.

This species is apparently new to Texas. Is resembles *U. cornuta*, Michx., but the flowers are about half the size of that species.

Plantago insularis Eastw. var, **fastigiata** (Morris) Jepson, Man. Fl. Pl. California 956. 1925.

P. minima Cunn., Proc. Ind. Acad. Sci. 1896: 202. 1897.

P. scariosa Morris, Bull. Torrey Bot. Club **27**: 117. 1900.

TEXAS: Brewster County, beds near Terlingua, Big Bend National Park, April 18, 1961, *D. S. Correll & R. C. Rollins 23631*; mouth of Tornillo Creek at Hot Springs on gravel bars, Big Bend National Park, April 22, 1966, *D. S. Correll & R. C. Rollins 32642*. Presidio County, on red and brownish black cobbly slope of small open canyon, about 24.5 miles southeast of Redford, February 7, 1965, *D. S. Correll 30682*.

This species, which heretofore has been known to occur from California to Utah and Arizona, is new to Texas. Its cottony leaves that grow in a dense clump and its broad scarious bracts are distinctive. My wife, who has been studying the genus *Plantago*, called my attention to this addition to the flora of Texas.

TEXAS RESEARCH FOUNDATION
RENNER, TEXAS

CANDOLLEODENDRON, A NEW GENUS OF THE LEGUMINOSAE (CAESALPINIOIDEAE)

RICHARD S. COWAN

When I studied the type of *Swartzia brachystachya* A. P. DC. in the DeCandolle Herbarium in 1953, I doubted that the species could be left in the genus to which it had been assigned by DeCandolle, but I was reluctant to make that decision with no other material available for study. Then, two Froes collections were received in materials borrowed from the Instituto Agronômico do Norte at Belém, Brazil; there is no doubt whatever that DeCandolle's type and these Brazilian collections are in all respects conspecific.

I have chosen the name for the new genus to commemorate one of the most perceptive pioneers in the study of tropical legumes, Aug. Pyrame DeCandolle.

Candolleodendron Cowan, gen, nov.

A *Swartzia* antheris basifixis uniformibus, stigma unilaterale stylo saepe curvato adapicem differt; a *Zollernia* alabastris globosis vel late ovalibus, petalo uno, foliis pinnatis, stigma unilaterale differt.

TYPE SPECIES: *Candolleodendron brachystachyum* (A. P. DC.) Cowan.

Candolleodendron brachystachyum (A. P. DeCandolle) Cowan, comb. nov. **Swartzia brachystachya** A. P. DeCandolle, Prod. **2**: 423. 1825: Mem. Leg. 408. May 1826.

Tree 3-7 m. tall, the branchlets glabrous and nitid, the stipules minute, triangular, ca. 0.4 mm. long and wide; leaves glabrous, pinnate, the petioles 4-6.5 cm. long, terete, the rachis terete, slender, 7.5-10 cm. long; leaflets 2-jugate. strongly discolorous, much paler beneath, elliptic, the base acute, the apex acute to subacuminate, the venation plane above but salient beneath, the primary vein-branches strongly ascending; inflorescence 8-9 cm. long, ramuliger-ous, the axis sparingly strigulose, the bracts persistent, triangular, ca. 0.4 mm. long and wide, minutely strigulose and ciliolate sparingly, the bracteoles lacking; pedicels 8-11

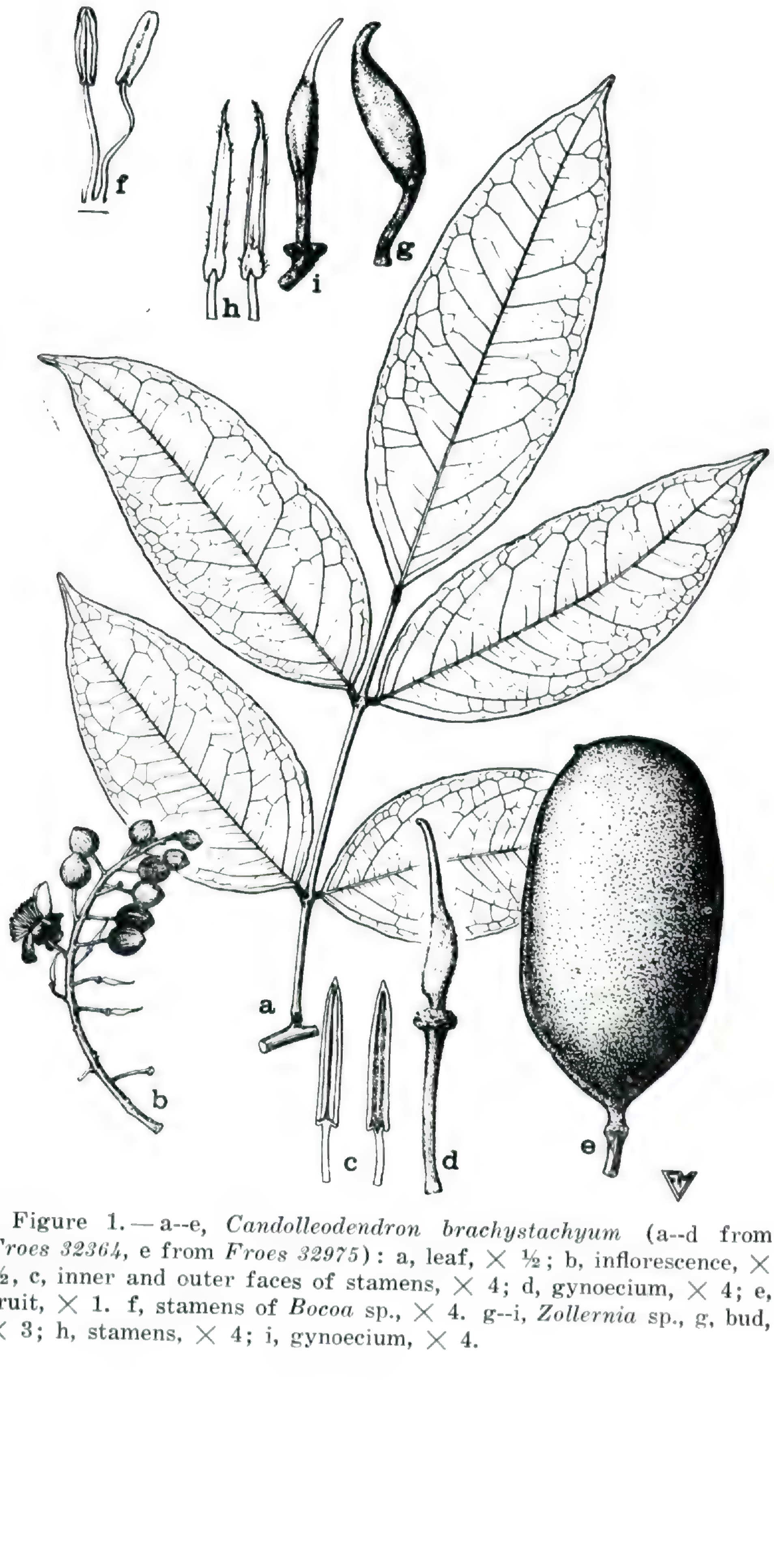

Figure 1. — a--e, *Candolleodendron brachystachyum* (a--d from *Froes 32364*, e from *Froes 32975*): a, leaf, × ½; b, inflorescence, × ½, c, inner and outer faces of stamens, × 4; d, gynoecium, × 4; e, fruit, × 1. f, stamens of *Bocoa* sp., × 4. g--i, *Zollernia* sp., g, bud, × 3; h, stamens, × 4; i, gynoecium, × 4.

mm. long, slender, sparingly strigulose, the buds globose to broadly oval in outline, sparingly strigulose, 9-11 mm. long and wide; calyx entire in the bud but opening in about four more or less equal segments, glabrous within, sparingly strigulose and irregularly striate externally, the striae brownish-red and longitudinally oriented; petal one, yellow, glabrous, the claw ca. 1.5 mm. long, the blade oval, concave, ca. 15 mm. long and 10 mm. wide; stamens numerous, uniform, glabrous, the filaments 1-2 mm. long, ligulate, the anthers basifixed, linear-lanceolate, acute to subacuminate, 5-6 mm. long, 0.6-0.8 mm. wide; gynoecium excepting the style sericeous, the stigma unilateral, obliquely oriented relative to the style, truncate, the style slightly uncinate or merely curved apically, 3.5-4.5 mm. long, glabrous, the ovary narrowly oblong, 3.5-4.5 mm. long, 1-1.5 mm. wide, the gynophore 0.4-0.8 mm. long; fruit (mature) oblong to oblong-oval, elliptic in cross-section, ca. 5.5 cm. long, 2.5-3 cm. wide, glabrous but finely tesselate (drying?) and distinctly verruculose (sublente), the carpophore ca. 2.5-3 mm. long, minutely strigulose; seeds not seen.

TYPE: *J. B. Patris* s. n. (holotype G-DC), "Cayenne."

Distribution: Lowland soils above level of seasonal inundation in French Guiana and along the lower reaches of tributaries of the Amazon River near its mouth.

Additional specimens examined:

BRAZIL: Pará: Municip. Porto do Móz: Left bank of Rio Xingú at Souzel, *Froes 32354* (IAN); Portel, Rio Tapacú, vicinity of the Rio Anapú, *Froes 32975* (IAN).

Earlier, in the course of my review of *Swartzia* and related genera, I had questioned the supposed near relationship of *Zollernia*, as well as that of several other presumed relatives. The new genus combines characteristics of *Swartzia*, *Zollernia*, and *Bocoa;* the latter shares with the new genus a common aspect of the leaves but there are obviously more characters in common with the other two relatives. The buds and petals of *Candolleodendron* are much like those of Swartzia but the basifixed, linear-lanceolate anthers and the form of the gynoecium are much more suggestive of *Zollernia*. Unlike either relative, *Candolleodendron* has

the style apex abruptly hooked or curved, with the stigmatic surface unilaterally disposed.

SMITHSONIAN INSTITUTION
WASHINGTON, D. C.

OBSERVATIONS REGARDING THE OCCURRENCE AND RELATIONSHIPS OF RUELLIA LORENTZIANA (ACANTHACEAE) IN SOUTHERN FLORIDA[1]

For a number of years taxonomists interested in the flora of southern Florida have been aware of a *Ruellia* not described in Small's manual of the Flora of Southeastern United States. Thus far the plant is known only as a naturalized weed on the grounds of the University of Florida Subtropical Experiment Station and immediate environs in Homestead, but it appears to be spreading aggressively into neighboring fields, particularly those disturbed by agriculture. Identification of these plants proved difficult, and transplants were grown in the experimental garden of the University of South Florida in order that individuals could be observed over a period of time. Vigorous plants yielding abundant fertile seeds were produced (fig. 1). They were compared with transplants of other species of *Ruellia* and proved to be distinctly unlike any other taxon from eastern United States, but similar to transplants of *R. occidentalis* (A. Gray) Tharp & Barkley (*R. nudiflora* Urban var. *occidentalis* Leonard) from Texas. Preliminary crossing attempts indicated that the unknown plants were intersterile with eastern United States taxa such as *R. caroliniensis* (J. F. Gmel.) Steud. and *R. succulenta* Small, but cross compatible with *R. occidentalis*.

[1]Contribution No. 23 from the Botanical Laboratories, University of South Florida. Aided by grant GB-1026 from the National Science Foundation.

Plate 1336. Garden culture of *Ruellia lorentziana.*

The following brief description based on garden cultures may serve to characterize the plants:

Erect, simple or divergently branching near the base, up to 0.9 m. high, stems quadrangular and grooved, covered with pale cystoliths, glabrescent below to eglandular-strigose above especially at the nodes and on young leaves and branches, larger internodes 11.6-13.7 cm.

long, larger leaves oblong-ovate to slightly cordate, blades 9.8-10.2 cm. long, 5.8-6.1 cm. wide, with conspicuously darker veins, margins obscurely to irregularly serrate, petioles 2.5-2.7 cm. long; inflorescence a narrow terminal panicle, densely glandular pubescent, sepals not keeled, corolla pale blue-violet, pubescent, capsule 2.2-2.4 cm. long, glandular pubescent, stalked, with 17-18 seeds.

REPRESENTATIVE SPECIMEN: FLORIDA, DADE Co., Homestead, spreading as weed on grounds of Univ. of Florida Subtropical Experiment Station. June 8, 1962, *R. W. Long 1130* (USF).

Although this plant clearly belongs to the *R. nudiflora-R. tuberosa* L. complex, it is not easily assigned to any of the species or varieties given by Leonard (Jour. Wash. Acad. Sci. 17:509-520, 1927). It is referred here provisionally to the Argentine species *R. lorentziana* Griseb., but it differs in having eglandular stems, sepals not keeled, and pubescent corollas.

Lindau (*In:* Die natürlichen Pflanzenfamilien 4(3b): 274-354, 1895) places *R. lorentziana* in sect. Dipteracanthus along with numerous other South American taxa, but places *R. tuberosa* in sect. Euruellia. This illustrates the highly unsatisfactory state of our understanding of this complex group of species that includes *R. tuberosa, R. nudiflora, R. intermedia* Leonard, and *R. lorentziana.*

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NOMENCLATURAL NOTES ON MONOCOTS

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In the course of preparing a flora of the vascular plants of Michigan, I have accumulated considerable data relating to the names of the native and introduced species of (chiefly) the Great Lakes region. It seems well to present these data in advance of the flora and with more documentation than will be appropriate therein. Rather than publish a diverse series of short notes, cluttering the literature with a paragraph or two each time a discovery arose, I have preferred to present such notes at one time for a major group of plants (in this case, the Monocotyledones). This report may then cause less pain to bibliographers and may even be more useful as a reference list for other students of the flora.

With the latter aim in mind, brief notes have been included on certain names for which good arguments have been published by others in the past — but too often and unjustifiably ignored. Thus, the present listing includes, in addition to some new combinations, most if not all of those instances where I consider the name of a local monocot in current manuals or monographs to require some clarification or replacement for largely nomenclatural (as distinguished from taxonomic) reasons.

Having previously discussed at some length (Taxon 14: 154-160. 1965) my interpretation of Article 46 of the International Code of Botanical Nomenclature and its plain requirement that the author *publishing* a name (i. e., supplying the description) be invariably cited (whether or not one takes the option of citing in addition a non-publishing author), I do not list below those instances in which only a change in author citation seems required, unless there are special reasons for discussing the case.

The following list is organized under names, in boldface type, which I feel are correct, although a few of them are ones which for taxonomic reasons I choose not to employ at present. Comments will be welcomed on overlooked publica-

tions, names, or interpretations which would alter the conclusions here set forth.

ACKNOWLEDGMENTS

Publications not available in Ann Arbor have been sought during several visits to the Missouri Botanical Garden, whose librarian, Dr. George Van Schaack, has been ever helpful. Every reference cited below has been examined by me, except for two specifically mentioned; not all references are cited, especially when a particular case has been thoroughly discussed and documented by others to whose work attention is called.

For help on certain specific points, as acknowledged in the text or footnotes, I am indebted to F. J. Hermann, B. Peterson, A. E. Schuyler, and W. T. Stearn. Over the years Dr. Rogers McVaugh has patiently saved me from many (doubtless not all!) nomenclatural blunders and guided me in application of the Code; he has kindly read the manuscript of the present paper but is, of course, not to be blamed for any errors or rashness which it may yet contain.

SPARGANIACEAE

Sparganium chlorocarpum Rydb. f. **acaule** (Beeby) E. G. Voss, *comb. nov.*

S. simplex var. *acaule* Beeby *in* Macoun, Cat. Canad. Pl. 2(5): 367. 1890.

The extreme state of this species deserves, at most, recognition in formal rank.

JUNCAGINACEAE

Triglochin maritimum L.

Triglochin palustre L.

These are the only two species described by Linnaeus (Sp. Pl., pp. 338, 339. 1753). Both epithets were given neuter form by him, the gender in accord with most Greek usage of the substantive adopted as the generic name. (Glochis, in contrast to triglochin, is chiefly feminine.) Since Linnaeus consistently employed the classical Greek gender for his genus, *Triglochin*, there seems to be no rea-

son at all, under Recommendation 73A(1) to alter it to feminine, as is often done in American publications (but not, e.g., in the treatment by Löve & Löve, Nat. Canad. 85: 156-165. 1958).

HYDROCHARITACEAE

Elodea Michx.

As has been carefully pointed out by Shinners (Rhodora 58: 162. 1956), *Elodea* is correct without the conservation once proposed for it. (Cf. Art. 75 examples, where *Elodea* is cited as a different name not likely to be confused with *Elodes* Adans. Not only was the latter misspelled *Elodea* by Jussieu (Gen. Pl., p. 255. 1789) but it was also given by him in the synonymy of *Hypericum*, which would give it no nomenclatural standing even if it were different.) Continued use of *Anacharis* instead of *Elodea* is incorrect.

GRAMINEAE

Triticeae Dumort.

As has been fully documented by the synonymy of Pilger (Bot. Jahrb. 76: 312. 1954), briefly summarized by Bowden (Canad. Jour. Bot. 37: 659. 1959), the tribal name Triticeae was validly published by Dumortier in 1823 (Obs. Gram. Belg., p. 82). Thus it has priority over Hordeae Benth. (Jour. Linn. Soc. Bot. 19: 31. 1881).

Agropyron dasystachyum (Hook.) Scribn. var. **psammophilum** (Gillett & Senn) E. G. Voss, *comb. nov.*

A. psammophilum Gillett & Senn. Canad. Jour. Bot. 39: 1170. 1961.

Typical var. *dasystachyum* of the plains tends to have the foliage less glaucous, the lemmas less villous, and the glumes less attenuate than does this endemic variety of the Great Lakes shores (cf. Guire & Voss, Mich. Bot. 2: 107-108. 1963). However, the differences do not seem to be as clearcut as implied by Gillett and Senn in describing the Great Lakes plant as a new species, and I prefer to consider the latter as a local variety in many ways paralleling *Calamovilfa longifolia* var. *magna* Scribn. & Merrill.

Agrostis stolonifera L. var. **palustris** (Huds.) Farw.

This combination by Farwell (Rep. Mich. Acad. 21: 351.

1920) should have been employed by Gleason (Ill. Fl. **1**: 166. 1952) rather than var. *compacta* Hartman (Skand. Fl. Handb., ed. 4, p. 24. 1843), since the former is based on the oldest epithet in varietal rank (*A. polymorpha* [var.] *palustris* (Huds.) Huds., Fl. Angl., ed. 2, p. 32. 1778).

Since *Agrostis alba* L. has been shown by Philipson (Jour. Linn. Soc. Bot. **51**: 91. 1937) to be based on a species of *Poa*, the familiar "redtop" grass may be called *A. stolonifera* var. *major* (Gaud.) Farw., as Gleason does in a conservative treatment, or *A. gigantea* Roth, as does Philipson (op. cit., p. 90). (The name *A. palustris* has sometimes been misapplied to this species.) Fernald's treatment of this group in Man., ed. 8, is unique and cannot be correlated with other works.

Agrostis hyemalis (Walt.) BSP. var. **tenuis** (Tuck.) Gleason f. **setigera** (Fern.) E. G. Voss, *comb. nov.*

A. scabra var. *septentrionalis* Fern. f. *setigera* Fern. Rhodora **35**: 210. 1933.

A. scabra [var. *scabra*] f. *tuckermani* Fern. *Ibid.* 207. 1933.

Errors and omissions in the synonymy of *Agrostis scabra* in Hitchcock's Manual of Grasses (ed. 2, pp. 807, 808. 1951) help to confuse the nomenclatural picture, especially if one chooses to follow Gleason in considering this plant to represent only a variety of *A. hyemalis*.

From the synonymy in Man. Gr., one might conclude that Gleason did not transfer the oldest available epithet in varietal rank, for "*Agrostis michauxii* var. *laxiflora* A. Gray, N. Amer. Gram. and Cyp. **1**: 17. 1834. Based on *Trichodium laxiflorum* Michx." antedates Tuckerman's epithet by nine years. However, Michaux's binomial (Fl. Bor.-Am. **1**: 42. 1803) is illegitimate, as he lists *Cornucopiae hyemalis* (the basionym of *A. hyemalis*) as a synonym. Michaux's superfluous name (Art. 63) is thus a synonym of *A. hyemalis* and not (if two species are maintained) of *A. scabra*, as listed in Man. Gr. and in Ind. Gr. Sp. (Chase & Niles, 1962).

Under Art. 72, Gray's varietal name is to be treated "as new," and not as a recombination of Michaux's illegitimate

epithet. Gray[1] provided no original description but cited the Michaux reference and figure, which is probably *A. scabra*. One might be able to interpret Gray's name as applying to the *A. scabra* concept; on the other hand, in the absence of a clear precedent in the Code, I consider it to fall in the same synonymy as Michaux's name and thus avoid the necessity of making yet another new combination. (Michaux's description is not clearly referable to either species, and because of his synonymy his type is the same as the type of *A. hyemalis* according to the controversial but often useful Art. 7, Note 4. Since the application of Michaux's name is governed by its type, and since Gray's name is validated only by reference to Michaux, Gray's type can be considered the same.)

If all of "*A. scabra*" is treated as a variety of *A. hyemalis* (as var. *tenuis*), then a single epithet is in order for the awned form. Of Fernald's two available epithets of the same date, I choose f. *setigera* as being more descriptive. Neither Fernald's var. *septentrionalis* nor f. *setigera* is listed in the synonymy of any taxon in Man. Gr. (although both are in Ind. Gr. Sp., 1962).

Andropogon gerardii Vitman

Article 73, Note 3, of the Code states that "wrong use of the terminations *i, ii*, . . . is treated as an orthographic error," but this does not completely solve the problem of what constitutes "wrong use." Rec. 73C states that if a personal name "is already Latin or Greek, the appropriate Latin genitive should be used." *Andropogon gerardi* has been defended on the grounds that there is a Latin form *gerardus*. But there is a Latin form for a great many names, and Rec. 73C does not refer to names which have a Latin form (i. e., have ever been Latinized by anyone) but to names which are "already Latin." I believe its intent is merely to avoid such barbarisms as *linnaeusii*. If one is basing a genitive epithet on the already-Latin

[1]I am indebted to Dr. A. E. Schuyler, of the Academy of Natural Sciences of Philadelphia, for examining for me a label from Gray's exsiccata. (For the significance of Gray's Gram. & Cyp., see Rickett & Gilly, Bull. Torrey Bot. Club. 69: 461-466. 1942.)

gerardus, then of course it must be *gerardi*, or at least not *gerardusii;* but if one bases it simply on the French name of Gérard, whom this plant honors, then it seems to me that Art. 73 prefers, for consistency, *gerardii.*

Aristida necopina Shinners

According to Shinners (Rhodora **56**: 30. 1954) this is the plant which, in the Midwest, has been referred to *A. intermedia* Scribn. & Ball; true *A. intermedia* is *A. longespica* Poir. var. *geniculata* (Raf.) Fern.

Bromus pubescens Willd. f. **glabriflorus** (Wieg.) E. G. Voss, *comb. nov.*

B. purgans L. f. *glabriflorus* Wiegand. Rhodora **24**: 92. 1922.

Wagnon (Rhodora **52**: 213-215. 1950; Brittonia **7**: 455. 1952) has indicated that the type of *B. purgans* L. belongs to the species long called *B. latiglumis* (Shear) Hitchcock, so that the older name supplants the latter. The plant long known (erroneously) as *B. purgans* then becomes *B. pubescens* Muhl. *ex* Willd. The above transfer is therefore necessary to make available a name for the rare form with the lemmas and paleas all completely glabrous.

Deschampsia cespitosa (L.) Beauv.

The epithet was originally spelled *cespitosa* by Linnaeus (Sp. Pl., p. 64. 1753). While this may be less preferable Latin than *caespitosa*, it was clearly not a typographical error (cf. Philos. Bot., No. 274, and other usage by Linnaeus), and alteration of the original spelling is unjustified.

Echinochloa muricata (Beauv.) Fern.

Echinochloa crusgalli (L.) Beauv. var. **frumentacea** (Link) W. F. Wight

The case for the name and author citations of *E. muricata* was adequately presented by Fairbrothers and Reeder (Rhodora **58**: 48 & 331-332, respectively. 1956.) Since *Panicum muricatum* Michx. is illegitimate, the basionym (under Art. 72) becomes *Setaria muricata* Beauv. In making the combination in *Echinochloa* (Rhodora **17**: 106. 1915), Fernald cited the Michaux reference, not Beauvois. Acceptance of Fernald as author of the combination seems to be a good illustration of Art. 33, Note 2 ("Bibliographic errors of citation do not invalidate the publication of a new combination.") — even though the "error" in this case is citing the

wrong author and hence place of publication of the basionym.

A similar situation involves the epithet *frumentacea*. *Panicum frumentaceum* Roxb. (Fl. Ind. **1**: 307. 1820), usually cited as the basionym, is an illegitimate homonym of *P. frumentaceum* Salisb. (Prod. Stirp. Hort. Chap. All., p. 18. 1796), which was itself an illegitimate substitute name for *Holcus sorghum* L. (cited as "Linn. Sp. Pl. ed. 2. p. 1404"). Therefore, *Echinochloa frumentacea* Link (Hort. Reg. Bot. Berol. **1**: 204. 1827) is, under Art. 72, treated "as new," and becomes the basionym of *E. crusgalli* var. *frumentacea*.

Eragrostis cilianensis (All.) E. Mosher

Shinners (Rhodora **56**: 26, 27. 1954) discussed the nomenclature of this species, tentatively attributing the combination to Hitchcock (whose 1919 usage is not a "nomen nudum" as termed by Shinners, for no description is required for a new combination and even citation of the basionym was not required prior to 1953 [Art. 33]). Shinners cautiously pointed out that it was possible that some author published the combination prior to Hitchcock. The name was used in Mosher's Grasses of Illinois (Ill. Agr. Exp. Sta. Bull. **205**: 381. 1918) — but Shinners' warning still stands: there may be yet a prior use.

Festuca pratensis Huds.

This name has been used for some time in Europe (the native home of the species) for what many manuals continue to call *F. elatior* L. (Sp. Pl., p. 75. 1753.), a name which may be rejected under Art. 69 as a nomen confusum; otherwise, it supplants *F. arundinacea* Schreb. (cf. Dandy, List Brit. Vasc. Pl., p. 157. 1958).

Koeleria macrantha (Ledeb.) Spreng.

Shinners (Rhodora **58**: 94. 1956) has pointed out not only that *K. cristata* Pers. is an illegitimate name but also that it applies to a European species, so that our American plant must apparently be identified as *K. macrantha*.

Panicum commutatum var. **ashei** Fern.

Not *P. ashei* Pearson in Ashe. Jour. Elisha Mitchell Sci. Soc. **15**: 35. 1898.

Panicum ashei Pearson was originally published as a nomen novum for *P. commutatum* Schult. var. *minor* Vasey.[2] The reference cited is Contr. U. S. Nat. Herb. **3**: 32 (1892) and not the original place of publication of var. *minor* (U. S. D. A. Bot. Div. Bull. 8: 34. 1889). However, Vasey's description is identical in both places, and bibliographic errors of citation do not invalidate the publication of a new combination (Art. 33, Note 2) — or, presumably, of a nomen novum. *Panicum ashei* and *P. commutatum* var. *minus* (as '*minor*') are synonymous. Since the latter is apparently not taxonomically distinct from typical *P. commutatum* (cf. synonymy of Hitchcock and Chase, and implication in Fernald, Rhodora **36**: 83. 1934), *P. ashei* also belongs in the synonymy of *P. commutatum*.

Fernald cited *P. ashei* Pearson as basionym for his new combination (loc. cit.), but definitely stated "excluding synonym." Fernald's varietal name must be treated as new, dating from 1934, validated by reference to the description and citations by Pearson in Ashe but specifically excluding the cited synonym which unfortunately makes the binomial *P. ashei* Pearson apply to a different plant from the varietal name *P. commutatum* var. *ashei* Fernald. Those who believe that the weakly distinguished var. *ashei* should be accorded specific rank will have to provide a new name for it. (The type of *P. ashei*, as a nom. nov., must be the type of *P. commutatum* var. *minus*. Hitchcock & Chase's designation of Ashe's 1898 collection from Ithaca as a type is irrelevant.)

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[2]Hitchcock and Chase (N. Am. Sp. Panicum, Contr. U. S. Nat. Herb. **15**: 301. 1919) argue that the synonym is cited in error and that *P. ashei*, as a "sp. nov." was not really intended as a nom. nov. However, the phrase following the listing of Vasey's name, "Not *P. capillare* var. *minus* Muhl. (1817)" indicates that Pearson (or Ashe) intentionally avoided creating a homonym of *P. minus* (Muhl.) Nash [Bull. Torrey Bot. Club **22**: 421. 1895]. Since Vasey's varietal epithet could thus not be raised to specific rank, a new name was required. Note, too, that no type was designated, whereas for truly new species in the same paper Ashe usually designated a type when more than one of his collections was cited.

Panicum depauperatum Muhl. var. **involutum** (Torr.) Wood
P. depauperatum var. *psilophyllum* Fern.

It is not clear why Fernald (Rhodora **23**: 193. 1921) found it necessary to provide a new name for "the common plant with sheaths sparsely pilose or quite glabrous" since Hitchcock and Chase (N. Am. Sp. Panicum, Contr. U. S. Nat. Herb. **15**: 151. 1910) had long previously noted that the type of *P. involutum* Torrey (Fl. No. & Mid. States, p. 144. 1824) had "sparsely pilose sheaths." Hence, Fernald's name is considerably antedated by *β involutum* (Torr.) Wood (Class-book, ed. 1860, p. 786).

Panicum rigidulum Nees
P. agrostoides Spreng.

As was pointed out long ago by Hitchcock and Chase (N. Am. Sp. Panicum, Contr. U. S. Nat. Herb. **15**: 100. 1910) Sprengel (Pl. Pugill. **2**: 4. 1815) cited *P. agrostidiforme* Lam. as a synonym of his proposed new *P. agrostoides*. Hence, under Art. 63, Sprengel's name is illegitimate as superfluous when published, for by citing Lamarck's name he apparently intended to circumscribe his species so as to include Lamarck's plant — even though Sprengel did in fact have something new.

As was also pointed out by Hitchcock and Chase (loc. cit.), *P. rigidulum* Bosc. *ex* Spreng. (Syst. Veg. **1**: 320. 1825) is a name merely published in synonymy (of *P. anceps* Michx.). Thus the 1825 name is invalid and has no status under the Code (Art. 12); it is not illegitimate. Hence, the later described *P. rigidulum* Bosc. *ex* Nees (Agrost. Brasil. [= Mart., Fl. Brasil. 2(1)], p. 163. 1829) is evidently the earliest correct name for this plant. (It is of interest to note that as long ago as 1897 (U. S. D. A. Div. Agrost. Bull. **4**: 21), Holm reported that the specimen of *P. agrostoides* in Willdenow's herbarium has "*P. rigidulum* Bosc." added by Willdenow on the label.)

Paspalum muhlenbergii Nash

Although described by Nash (Britton, Man., p. 75. 1901) as a species distinct from "*Paspalum pubescens* Muhl.," this was not maintained as a distinct entity by Mrs. Chase (N. Am. Sp. Paspalum, Contr. U. S. Nat. Herb. **28**: 83. 1929)

or by Fernald (Rhodora **36**: 20. 1934). Mrs. Chase used the name *P. pubescens* Muhl. both in her monograph and in the revised edition of the Manual of Grasses (as had Hitchcock in the original edition), in spite of the fact that in the monograph (loc. cit.) she herself stated: "Willdenow cites *P. ciliatifolium* Michx. as a synonym."

Thus, *Paspalum pubescens* Muhl. *ex* Willd. (Enum. Plant. Hort. Reg. Bot. Berol., p. 89. 1809) is an illegitimate name, superfluous when published (Art. 63). Not only does Willdenow quote Michaux's description fully (after his own), but "*Habitat in* Carolina" is also apparently taken from Michaux. Although the type sheet of *P. ciliatifolium* Michx. (Fl. Bor.-Am. **1**: 44. 1803) is mixed (Chase, op. cit., p. 86), Willdenow gives no evidence of intentionally basing his species on one of the included elements. Whatever specimens Muhlenberg or Willdenow may have had before them, they are irrelevant to the nomenclatural situation of proposing what is, in effect, a substitute name.

If one does not follow Fernald in treating these plants as *P. ciliatifolium* var. *muhlenbergii* (Nash) Fern., they must be called *P. muhlenbergii* Nash. *P. pubescens* Muhl. ex Willd. must be cited in the synonymy of *P. ciliatifolium* Michx.

Phalaris arundinacea L. f. **variegata** (Parnell) Druce
P. arundinacea f. *picta* (L.) Asch. & Graebn.

The combination by Druce (Fl. Berks., p. 556. 1897) was clearly based on *P. arundinacea* var. *variegata* Parnell (Gr. Brit., p. 188. 1845). The latter was evidently intended as a new taxon (no prior authors are cited in the manner employed by Parnell for most other taxa), although the variety is undoubtedly the same as *Calamagrostis variegata* Withering (Bot. Arr. Brit. Pl., ed. 3, **2**: 124. 1796). Since Withering cited *P. arundinacea* L., his binomial is superfluous anyway, and could not serve as basionym for Parnell's name, which in any event, therefore, is treated as new — although it was taxonomically unnecessary in view of *P. arundinacea* var. *picta* L. (Sp. Pl., p. 55. 1753).

The later formal combination by Ascherson and Graebner (Syn. Mitt.-Eur. Fl. **2**: 24. 1898), based on *P. arundinacea*

[var.] *picta* L. (the page number they cite [80] is that of Sp. Pl., ed. 2, although said to be ed. 1), is taken up by Anderson in his recent monograph of *Phalaris* (Iowa State Jour. Sci. **36**: 38. 1961). Neither Anderson nor Chase and Niles (Ind. Gr. Sp., 1962) nor Man. Gr. list f. *variegata,* and the latter two do not list f. *picta.* Hence, it seems valuable to summarize the nomenclature. The attractive "Ribbon Grass" may be called *P. arundinacea* var. *picta* L. or f. *variegata* (Parnell) Druce — but not f. *picta* nor var. *variegata* (unless, of course, one makes the taxonomic judgment that there exist two different taxa of ribbon grass).

Puccinellia fernaldii (Hitchc.) E. G. Voss, *comb. nov.*

Glyceria pallida (Torr.) Trin. var. *fernaldii* Hitchcock, Rhodora **8**: 211. 1906.

Glyceria fernaldii (Hitchc.) St. John, Rhodora **19**: 76. 1917.

Torreyochloa fernaldii (Hitchc.) Church, Am. Jour. Bot. **36**: 164. 1949.

Torreyochloa pallida (Torr.) Church ssp. *pallida* var. *fernaldii* (Hitchc). Dore, Canad. Jour. Bot. **42**: 874. 1964.

This combination is proposed with some reluctance, but it is necessary if one follows the suggestion of Clausen (Rhodora **54**: 42-45. 1952) that *Torreyochloa* Church (the *Glyceria pallida* group) be treated as a section of *Puccinellia.* In defending *Torreyochloa,* Church (Rhodora **54**: 187-200. 1952) questioned the recognition of *fernaldii* at specific rank, and Clausen evidently had doubts on this point also. Since in Michigan it is morphologically and geographically distinct from *P. pallida* (Torr.) Clausen, I recognize it, at least at present.

Setaria glauca (L.) Beauv.

Reeder (Rhodora **53**: 27-30. 1951) discussed this name under the title: "Setaria lutescens an Untenable Name." Rominger in his recent monograph of *Setaria* (Ill. Biol. Monogr. No. 29, pp. 97-98. 1962) rehashes the old arguments against *S. glauca,* rejects Reeder's conclusion with a backhanded compliment (referring to it as a strong argument and nowhere directly refuting it), and ignores completely Reeder's assertion that the assumed basionym, *Panicum lutescens* Weigel, cannot in any event be accepted

since it is invalid under Art. 33, which requires for valid publication that an author definitely indicate that an epithet is to be used in a particular combination.

Weigel's publication was first questioned by Weatherby, et al. (Rhodora **31**: 109. 1929), who stated that he "nowhere directly makes the combination *Panicum lutescens*." Exactly the same assertion ("nowhere") is made by Reeder. Unfortunately for this argument, "nowhere" is not true. In the explanation of his plates, Weigel (Obs. Bot., 1772) does indicate that on Plate II, Fig. 1 is "of *Panicum lutescens*" ["Panici lutescentis"] and Fig. 2 is of *Panicum virescens*. With this evidence of his intent in proposing (p. 20) the epithets, I think we must accept them as validly published binomials. Otherwise, for those who are convinced that *S. glauca* is incorrect, the basionym must presumably become, under Art. 72, *Chaetochloa lutescens* Stuntz (U. S. D. A. Bur. Pl. Ind. Inv. Seeds & Pl. Imp. **31**: 86. 1914 — incorrectly cited as p. 84 by Weatherby and as p. 83 by Reeder).

Sorghum bicolor (L.) Moench

S. vulgare Persoon

A clear summary of this rather clearcut but often ignored case has been given by Shinners (Baileya **4**: 141-142. 1956). *Sorghum bicolor* was specified as the type of the genus by Clayton in his proposal for conservation of *Sorghum* (Taxon **10**: 242, 243. 1961). To the usual synonymy of this species (e.g., Snowden, Cultivated Races of Sorghum, p. 166. 1936) should be added *Panicum frumentaceum* Salisb. (cf. under *Echinochloa*, above).

Spartina pectinata Link var. **suttiei** (Farwell) Fernald

It is extremely doubtful whether this variety has any taxonomic significance whatsoever, and it is mentioned here only to call attention to a slight correction necessary in the indication of type locality in Man. Gr. (rev. ed., p. 959. 1951) and in the Ind. Gr. Sp. (Chase & Niles, 1962). These sources give "Orchard Lake, Mich., *Suttie*" in designating the type. However, in describing *S. michauxiana* var. *suttiei*, Farwell (Rep. Mich. Acad. **21**: 352. 1920) said: "Island Lake, July 16, 1905, No. 1487a. Also Dr. George

Suttie, Orchard Lake, July 29, 1892, and Waterford, August 27, 1893." Priority in this listing is given to Island Lake, and further confirmation is Farwell's specimen No. 1487a, marked "Type" by him (BLH), as pointed out by McVaugh, Cain, & Hagenah (Farwelliana, Cranbrook Inst. Sci. Bull. 34: 71. 1953). The type locality is Island Lake [Livingston Co.], not Orchard Lake [Oakland Co.], Michigan, the type being *Farwell 1487a.*

Sporobolus vaginiflorus (Torr.) Wood var. **neglectus** (Nash) Scribn.
S. vaginiflorus var. *neglectus* (Nash) Shinners

Scribner's combination (Am. Gr. 2, U. S. D. A. Div. Agrost. Bull. 17, rev. ed., p. 170. 1901) considerably antedates the same combination by Shinners (Rhodora 56: 29. 1954), but what started as a routine check on an apparently obvious duplication revealed a tangle of confused citations, upon which some light has already been shed by Rickett & Gilly (Bull. Torrey Bot. Club 69: 463. 1942).

Scribner used the spelling *S. vaginaeflorus*, and the first source which might lead one astray (and suggest that Shinner's combination was indeed required) is the Gray Index card for "*Sporobolus vaginaeflorus* Vasey, not Wood." First of all, the reference on this card to Vasey in Watson & Coulter (Man., ed. 6, p. 645. 1889) is later than Vasey, Cat. Gr. U. S., p. 45 (1885). Secondly, there is no justification for the assertion "Vasey, not Wood." Vasey (1885) cited "(Vilfa, *Torr.*)" — which is more of a basionym than one might have expected, or than was required as of that date. I see no reason to question that Vasey's *Sporobolus vaginaeflorus* is based on *Vilfa vaginiflora* Torr. (in Gray, N. Am. Gram. & Cyp. 1: 3. 1834). Rickett & Gilly (loc. cit.) have pointed out that Torrey later used the spelling *vaginaeflora* (Fl. N. Y. 2: 438. 1843). These are merely orthographic variants, and the present Code (Rec. 73Gd) favors the first spelling as the correct form. The combination by Wood (Class-book, ed. 1860, p. 775) antedates Vasey's and has the same basionym ("vaginaeflorus Torr."). If *S. vaginaeflorus* Wood and *S. vaginaeflorus* Vasey are indeed the same, Scribner's 1901 var. *neglectus* is correct with the former specific combina-

tion, for those who do not consider *S. neglectus* a distinct species.

Sporobolus vaginiflorus (Torr.) Wood

This combination, as noted above, is based on *Vilfa vaginiflora* Torr. (in Gray, Gram. & Cyp. **1:** 3. 1834). This is often cited "Torr. *ex* Gray," but a study of the situation suggests that this is not the case and, moreover, that the type locality is generally given erroneously. The printed label with Gram. & Cyp. 1: 3 reads as follows:

> 3. Vilfa vaginiflora. *Torrey, Synop. Flora, ined.*
> Agrostis Virginica. *Muhl. Gram. p.* 74, *Torrey, Flora, v.* 1, *p.* 89, *non Elliott et Auct.*
>
> HAB. — Dry barren fields, New-Jersey.

What is being proposed is a nomen novum for *Agrostis virginica* sensu Muhlenberg (and, later, Torrey). The true *A. virginica* L. [= *Sporobolus virginicus* (L.) Kunth] occurs (or occurred) from southeastern Virginia and North Carolina along the coast to Texas (and southward). The more northern plant, previously confused with it, required a new name. This was proposed by Torrey in manuscript and published by Gray, the publication validated by reference to a previously published description [Muhlenberg (1817) antedates Torrey (1824) and is cited first].

If a description had been required, and had been provided by Gray for Torrey's name, the citation would be "Torrey *ex* Gray." Since no description was required, Torrey's recognition of the need for a new name presumably required no further work on the part of Gray, and "Torrey *in* Gray" is an acceptable citation (as it would be assumed for a new combination, for which a description is also not required; cf. Voss, Taxon **14:** 154-160, esp. p. 158. 1965).

Since the new name was validated by reference to a previous description, the New Jersey collection of Gray's Gram. & Cyp. has no relevance to the selection of a type, which would be the same as that for the plant previously described under the mistaken identity (Art. 7, Note 4). Muhlenberg (p. 75) stated: "Habitat in aridis, floret Sept. Penns. Carolina, Georgia." Since Pennsylvania plants would be personally familiar to him and would undoubtedly be *vagini-*

flora rather than true *virginica*, the type locality would more likely be Pennsylvania than the Carolinas or Georgia. It would in any event not be New Jersey, a state not included in the description.[3]

Trisetum spicatum (L.) Richt. var. **molle** (Kunth) Beal
Trisetum spicatum var. **maidenii** (Gandoger) Fernald

As is clear from the recent treatment of the complex by Hultén (Sv. Bot. Tidskr. 53: 203-228. 1959), the wide-ranging *Trisetum spicatum* is taxonomically complicated. In Gray's Manual, ed. 8, Fernald adopts the varietal treatment proposed by him earlier (Rhodora 18: 195-198. 1916). I do not at this time intend to imply that this treatment (including the varieties named above) is necessarily the most helpful, but want merely to call attention to necessary corrections in citation for two of Fernald's three varieties (the third, var. *pilosiglume*, was described as new by him).

The Rhodora treatment of *T. spicatum* var. *molle* (Michx.) Piper was corrected to var. *molle* (Michx.) Beal in the Manual (p. 145). However, the basionym is incorrectly attributed to Michaux, for Michaux's *Avena mollis* was (as is clear, e.g., from the synonymy in Man. Gr., rev. ed., p. 977. 1951; in Hultén, op. cit.; and in Chase & Niles, Ind. Gr. Sp., 1962) illegitimate when published, being a homonym of two earlier names.

Trisetum molle of Kunth (Rév. Gram. 1: 101. 1829), based on *A. mollis* Michx., is therefore, under Art. 72, treated as new. Since Beal (Gr. N. A. 2: 377. 1896) cited Kunth as well as Michaux, the authorship of the variety should be cited as var. *molle* (Kunth) Beal. Similarly, those who follow Hultén's treatment would have ssp. *molle* (Kunth) Hultén.

A further discussion of this species complex has recently been published by Löve and Löve (Univ. Colo. Stud. Ser. Biol. 17: 608. 1965), who recognize the illegitimacy of Michaux's name but neglect to observe that Kunth's name

[3]I am indebted to A. E. Schuyler and C. W. Laskowski, who have examined the Muhlenberg collections in the Academy of Natural Sciences of Philadelphia in an unsuccessful search for a specimen with data which might definitely determine the type locality.

(which they date from 1833 rather than 1829) is legitimate (by Art. 72) although it may be a taxonomic synonym of *Melica triflora* Bigel. and therefore may serve as a legitimate basionym for combinations in other ranks, e.g., *T. spicatum* ssp. *molle* (Kunth) Hultén or *T. triflorum* ssp. *molle* (Kunth) Löve & Löve (the latter combination, as published with Hultén as author of basionym, an example of bibliographic error of citation).

The variety *T. spicatum* var. *maidenii* (Gandoger) Fern. is based, according to the citations in Rhodora (op. cit.), in the Gray Index, in Hultén (op. cit.), and in Ind. Gr. Sp., on *T. subspicatum* f. *maidenii* Gandoger (Bull. Soc. Bot. France 49: 182. 1902). Whether this incorrect citation is repeatedly given as a result of independent error or uncritical copying I do not know. But the original publication of *T. subspicatum* f. *maidenii* Gandoger was three years earlier (Bull. Soc. Bot. France 46: 393. 1899). The 1902 note was merely a defense of the validity of the taxon, it having been challenged by Maiden (quoted, op. cit. 49: 72. 1902). The use of boldface type in the indices of these volumes to indicate new taxa clearly supports the intent of the 1899 publication, which was complete with Latin diagnosis, to describe a new form.

CYPERACEAE

Carex

One of the most brutal products of Fernald's acid (and usually accurate!) pen was his review (Rhodora 49: 49-52. 1947) of Beetle's conspectus of sections in the genus *Scirpus*. Under the title, "Unverified Bibliography of Scirpus," Fernald called attention to a number of supposed sectional names which were not published as sections by the authors to whom Beetle attributed them. It is, therefore, not a little surprising to find in Fernald's own edition of Gray's Manual (1950) 58 sections recognized in the genus *Carex*, most of which are subject to the same criticisms previously leveled at Beetle's *Scirpus* sections.

I will not take the space here to itemize the several supposed sectional names in *Carex* which I have checked and

found not to have been validly published in that rank or, if so published, not by the author to whom ascribed in the Manual. Since such names are not in the usual indexes, and only partial synonymies appear in monographs, the work of verifying all of them is a task of greater magnitude than I have the time or competence to undertake when it is not required. The simple solution is to refer to the traditional names in *Carex* as merely names of convenient groups, without nomenclatural standing and not designated as sections.

Even so, it would be in the spirit of the Code to change the designation of the group long known as Acutae to Carex, since it is the group which includes *C. acuta* L., the type species of the genus. (This change would be required, under Art. 22, in the rank of section.)

Carex bebbii (Bailey) Fern.

This name is usually attributed to Olney (Car. Bor.-Am. 2: 12. 1871), but as is clear from Mackenzie (N. Am. Fl. 18: 147. 1931), the first valid publication of the epithet was as *C. tribuloides* var. *bebbii* Bailey (Mem. Torrey Bot. Club 1: 55. 1889). The combination in specific rank was made (apparently more or less inadvertently) by Fernald (Proc. Am. Acad. 37 [= Contr. Gray Herb. 22]: 478. 1902,) who also pointed out that Olney's name was a nomen nudum. Mackenzie (op. cit., p. 148) observed that the few words by Bailey earlier (Bot. Gaz. 10: 379. 1885) "can scarcely be regarded as a publication of the name"; regardless of the number of words, Bailey at that point considered *C. bebbii* to be a synonym of either *C. lagopodioides* or *C. scoparia* — in any event, the name is there only in synonymy and hence without nomenclatural standing.

Carex communis Bailey f. **gynandra** (Farwell) E. G. Voss, *comb. nov.*

C. communis var. *gynandra* Farwell, Am. Midl. Nat. 12: 52. 1930.

It is doubtful whether taxa such as this merit recognition even in the rank of form, but the above combination is made for consistency with, e.g., *C. pensylvanica* f. *androgyna* F. J. Hermann.

Carex houghtoniana Dewey

C. houghtonii Torrey

As was pointed out by Butters and Abbe (Rhodora 55:

134. 1953) and Rittenhouse and Voss (Mich. Bot. **1**: 66. 1962), *C. houghtoniana* Torrey *ex* Dewey (Am. Jour. Sci. **30**: 63. 1836) is validly published and there is no sanction in the Code for Torrey's emendation to *C. houghtonii* (Ann. Lyc. Nat. Hist. N. Y. 3: 413. 1836).

Carex hystericina Willd.

The original spelling was *C. hystericina* Muhl. *ex* Willd. (Sp. Pl., ed. 4, 4(1) : 282. 1805) and in the absence of any evidence that Willdenow committed an unintentional orthographic error, emendation to *C. hystricina* is unjustified — as in the previous instance.

Carex lasiocarpa Ehrh. var. **latifolia** (Boeckl.) Gilly

C. lasiocarpa var. *latifolia* (Boeckl.) Gleason

C. lanuginosa Michx.

Although I prefer to recognize *C. lanuginosa* as a good species, it is perhaps worth noting that the combination by Gleason (Phytologia **4**: 22. 1952) used in the Ill. Fl. (**1**: 349. 1952) is quite unnecessary, having been made six years previously by Gilly (Iowa St. Coll. Jour. Sci. **21**: 125. 1946), with good bibliography. Gleason's combination is therefore properly not included in the Gray Index.

Carex leptalea Wahl. var. **harperi** (Fern.) Weathb. & Grisc.

C. leptalea ssp. *harperi* (Fern.) Stone

The varietal combination is usually attributed to Stone (Pl. So. N. J., p. 305. 1912), whose work clearly indicates that his trinomials were intended to represent subspecies (cf., e.g., pp. 35 & 119). The first use of the epithet in varietal rank was apparently by Weatherby & Griscom (Rhodora **36**: 39. 1934). Stone's subspecific combination is given as an undesignated trinomial in the Gray Index. The unnecessary "comb. nov." as subspecies by Calder and Taylor (Canad. Jour. Bot. 43: 1391. 1965), based on "var." *harperi*, presumably resulted from failure to examine Stone's publication carefully.

Carex livida (Wahl.) Willd. var. **radicaulis** Paine

C. livida var. *grayana* (Dew.) Fern.

In publishing var. *grayana*, Fernald (Rhodora 28: 8. 1926) stated that to take up Paine's name for " a very exceptional departure" would "lead only to confusion." Unfortunately, the Code makes no allowance for exclusion of a

name based on an unusual specimen if it is included in a taxon as circumscribed, and hence the varietal name of Paine (Rep. N. Y. St. Cab. 18: 159. 1865) has priority over Fernald's superfluous name.

Carex rugosperma Mack. var. **tonsa** (Fernald) E. G. Voss, *comb. nov.*
C. umbellata Willd. var. *tonsa* Fern. Proc. Am. Acad. **37**[= Contr. Gray Herb. **22**]: 507. 1902.

Sufficient intermediacy exists between *tonsa* and typical *C. rugosperma* that varietal status for the former seems desirable. Those who follow such *Carex* authorities as Mackenzie and Hermann in applying the name *C. umbellata* Willd. to what Fernald calls *C. abdita* Bickn. will require this combination with *C. rugosperma* Mack. (*C. umbellata* sensu Fern. et al., not Schk. *ex* Willd.).

Eleocharis erythropoda Steudel
E. calva Torrey

Svenson (N. Am. Fl. 18: 525. 1957) clarified the nomenclature of this species. It is discouraging to contemplate for how many years the plant was called *E. calva* Torr. (Fl. N. Y. 2: 346. 1843), when Torrey merely mentioned certain specimens at the end of a paragraph under *E. palustris* and stated: "It may be regarded as a provisional species, under the name of *E. calva*." No more straightforward example of a "provisional name," invalid under Art. 34, can be imagined.

Since a name not validly published has no status under the Code (Art. 12) — i.e., is not even illegitimate — later valid publication of *E. calva* would not be considered a homonym. Such publication evidently did not occur, however, prior to *E. erythropoda* Steud. (Syn. Pl. Glum. II, Cyp., p. 76. 1855).

Rhynchospora glomerata (L.) Vahl var. **minor** Britton
R. glomerata var. *capitellata* (Michx.) Kuek.

The combination by Kükenthal (Bot. Jahrb. **75**: 98. 1950) is illegitimate; he cites *R.* "*capitellata*" [error for *glomerata*] var. *minor* Britt. (Trans. N. Y. Acad. **11**: 89. 1892) in synonymy. Those who wish to follow his taxonomic disposition of *R. capitellata* (Michx.) Vahl should use the latter name. The spelling *Rhynchospora* is con-

served, a point apparently overlooked by some recent authors who have used *Rynchospora*.

JUNCACEAE

Luzula multiflora (Retz.) Lejeune

Being reluctant to propose a new name for this well known species, I believe the Code can be interpreted to allow retention of the familiar name. The nomenclatural problems have been discussed only in part by Fernald (Rhodora 47: 268-271. 1945) and by Hylander (Uppsala Univ. Årsskr. 7: 109-110. 1945). The chief synonyms and their status may be summarized as follows:

Juncus multiflorus Retz. (Fl. Scand. Prodr., ed. 2, p. 82. 1795)
[Not *J. multiflorus* Desf. (1798) (fide Hylander).]

Juncus intermedius Thuill. (Fl. Env. Paris, ed. 2, p. 178. 1799)
[Not *J. intermedius* Host (1805).]

Juncus multiflorus Ehrh. ex Hoffm. (Deutschl. Fl., rev. ed., **1**: 169. 1800) [Illeg. as homonym of Retz. (1795) if based on different type.]

Juncus erectus Pers. (Syn., p. 386. 1805)
[Illeg. as superfluous under Art. 63.]

Luzula multiflora Lej. (Fl. Env. Spa, p. 169. 1811)
[Based on *J. multiflorus* Hoffm., with *J. intermedius* Thuill. & *J. erectus* Pers. as synonyms (fide F. J. Hermann, in litt.).[4]]

Luzula intermedia Spenner (Fl. Friburg. **1**: 177. 1825)
[*J. multiflorus* Hoffm. cited as synonym, and also cited under *β multiflora* as is *L. multiflora* Hagenb.]

Since Hagenbach (Tent. Fl. Basil., p. 336. 1821) included *J. intermedius* Thuill. in the synonymy of his L. "multiflora Hoffm.," we can interpret this as the assumed basionym of Spenner's *L. intermedia*. Under *α congesta*, Spenner's only other var., *J. congestus* Thuill. is cited and is obviously the basionym. In any case, Spenner's binomial is illegitimate as a homonym of *L. intermedia* Baumg. (1816) and of Nocca & Balbis (1816), both of which were (fide Hermann) based on *J. intermedius* Host. The 1816 names should be treated as new, however, under Art. 72, since the name of Host (Icon. Descr. Gram. Austr. 3: 65. 1805) is superfluous under Art. 63, for he cited *J. glabratus* Hoppe (*ex* Rostk., Monogr. Gen. Junc., p. 27. 1801). (Host cited no publication, and was perhaps unaware that Hoppe's unpublished name had been validated by Rostkovius.)

Fernald apparently assumed that *L. multiflora* Lejeune was based on *J. multiflorus* Retzius. Unfortunately Lejeune[4] did not cite Retzius, but Hoffman (which was based on a presumed nomen nudum of Ehrhart, as described by Fernald,[5] and on *J. campestris* β of the Flora Lapponica). Hoffman's name, if based on a different type, is a homonym of that of Retzius; but Lejeune's name cannot be treated as new under Art. 72 since it would be nomenclaturally superfluous under Art. 63 (as he included the prior *J. intermedius* Thuill. in his synonymy). Furthermore, it would be taxonomically superfluous if not based on *J. multiflorus* Retz., if we assume the latter to be the same species as *J. multiflorus* Ehrh. *ex* Hoffm. (as is maintained, e.g., by Buchenau, Pflanzenr. IV (36) : 94. 1906).

Juncus multiflorus Hoffm. is a homonym of *J. multiflorus* Retz. only if it is based on a different type (Art. 64). There is, of course, the remote possibility that the two names are not based on different types and that Retzius also had a sheet No. 127 from Ehrhart's exsiccata as cited by Hoffman[5]. Unfortunately, Retzius cited no such specimen, and I am informed by B. Peterson of Lund (in litt., 1958) that no specimen named *J. multiflorus* can be found in Retzius' herbarium (nor in the Riksmuseum nor in Bergius' herbarium in Stockholm). Although no help is thus available

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[4]I am indebted to Dr. F. J. Hermann for checking the Lejeune and some other references for me and for considerable helpful correspondence (1957-1959) on this problem — although he is not to be held responsible if I have reached any erroneous conclusions.

[5]Fernald expressed some doubt as to the status of a 13th decade of Ehrhart's exsiccata, and appears not to have observed that on the 7th (unnumbered) page of his Introduction, Hoffman cites "*Ehrhart's, Calamariae, Gramina et Tripetaloideae Linn.* Dec. 1-14. 1789-1793. Fol." Additional evidence is that Buchenau, in his monograph (Bot. Jahrb. **12:** 162. 1890), cites "Collect. EHRHART, Calam., 127 (!)" under *L. campestris* var. *multiflora*, although the highest number cited in the "Index collectionum" (p. 473) is 126. Ehrhart's specimens seem to have been intended to illustrate authoritatively the Linnaean species, and one cannct help noting the striking coincidence (if indeed it is that) that No. 127 is the same number as *Juncus campestris* β in the Flora Lapponica, the only other reference cited by Hoffman under *J. multiflorus*.

to make clear what Retzius had, there is the additional possibility that Hoffman was aware of the earlier name and used it without citing its author.

In view of the uncertainties here suggested, the fact that *J. multiflorus* Retz. and *J. multiflorus* Hoffm. apparently refer to the same species whether or not based on the same type, and the desirability of a stable nomenclature, the best solution seems to me to invoke Art. 33, Note 2: "Bibliographic errors of citation do not invalidate the publication of a new combination." (Cf. comment under *Echinochloa*, above.) We can accept *Luzula multiflora* (Retz.) Lej. if we treat Lejeune's citation of Hoffman rather than of Retzius as a bibliographic error. This course would also explain Lejeune's failure to base his binomial on the earlier *J. intermedius* Thuill., which he cites.

It is not clear that there is any fully satisfactory alternative other than a new name. Without laboring the point further here, suffice it to say that several other epithets which (from Index Kewensis or other sources) might be thought applicable have been checked by Hermann or me and found to be taxonomically or nomenclaturally inadmissible. If *L. multiflora* and *L. congesta* are considered conspecific, one could take up *L. congesta* (Thuill.) Lej. (op. cit., p. 168) for the species and make *multiflora* a variety or subspecies of it. [Spenner (op. cit., p. 178) was evidently the first to treat *multiflora* in varietal rank, under his *L. intermedia;* if we are, in this line of thought, rejecting Hoffman's name as a homonym of Retzius's name, then it is illegitimate and Spenner's varietal use of the epithet would be treated as new. There may even be some earlier epithet available in varietal rank.] This is not the place for a monograph of *Luzula*, and I leave the subject with attention called to the unusual nomenclatural complexities.

LILIACEAE

Hemerocallis lilio-asphodelus L.

H. flava (L.) L.

Continued use by some authors of the illegitimate *H. flava* suggests that it is not inappropriate to call attention to dis-

cussions of the case by Farwell (Am. Midl. Nat. 11: 51. 1928), Hylander (Uppsala Univ. Årsskr. 7: 112. 1945), and Dress (Baileya 3: 107-108. 1955). The original *H. liliasphodelus* L. must be retained for one of the two elements into which it was later divided — even if the later divider was the revered Linnaeus himself.

Muscari atlanticum Boissier & Reuter

M. racemosum Auct., non Miller, non DeCandolle

This common grape-hyacinth, which occasionally escapes from cultivation, was originally called *Hyacinthus racemosus* L. (Sp. Pl., p. 318. 1753). In 1768, Miller (Gard. Dict., ed. 8, no. 3) described a *Muscari racemosus*, which too many authors (e.g., Fernald) have assumed to be based on *H. racemosus* L. However, it is clear, from the Clusian synonym which both cite and from the common names given, that Miller was instead providing a new name for the musk-hyacinth, *H. muscari* L. (p. 317). In order to avoid the tautonym *Muscari muscari* when transferring these species into *Muscari*, Miller was perfectly correct (according to present rules) in providing a new epithet. He was free to use any epithet he wanted (provided it was not otherwise in use in *Muscari*), and it is unfortunate that he happened to select a common epithet, already in use by Linnaeus for another species which ought to have been transferred to *Muscari*.

Therefore *Muscari racemosum* Mill. (loc. cit.)[6] applies to the species later called *M. moschatum* Willd. (Enum. Pl. Hort. Reg. Bot. Berol., p. 378. 1809), the name by which it usually appears in works on cultivated plants. Even if one should now reject *M. racemosum* Mill. as a *nomen am-*

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[6]When making the transfers into *Muscari* under the binomial system (Gard. Dict., ed. 8. 1768), Miller treated the generic name as masculine; Hylander (Uppsala Univ. Årsskr. 7: 38. 1945) has therefore termed incorrect the usual usage as neuter. However, valid publication of the genus dates from the 4th abridged edition of Miller's Gardeners Dictionary (1754), wherein the genus was consistently treated as neuter. The fact that Miller changed his mind 14 years later does not alter the original gender, which followed that of Tournefort, and which has been followed by Medicus, DeCandolle, and Turrill (in the works cited here), as well as others.

biguum under Art. 69, the plant cannot be called *M. moschatum*, since the latter name is distinctly antedated by *M. muscarimi* Medicus (Ann. Bot. Usteri 2: 15. 1791), a name clearly proposed as a substitute for *Hyacinthus muscari* L. in a paper on the Linnaean genus *Hyacinthus*. Medicus cites not only the Linnaean name (transfer of which would have created a tautonym) but also the Clusian synonym. (Cf. Turrill, Bot. Mag. 167, sub t. 124. 1950). [Another alternative, for those who prefer small genera, is *Muscarimia muscari* (L.) A. Losink., Fl. URSS 4: 411. 1935.]

The combination "*Muscari racemosum* (L.) DC.," which is often seen, is of course a homonym of *M. racemosum* Mill., and therefore illegitimate even if it were based on the Linnaean name. However, DeCandolle (in Lam. & DC., Fl. Franç., ed. 3, 3: 208. 1805) cited first, *M. racemosum* Mill., and second, *H. racemosus* L. "Spec. 455" [a reference to the 2nd (or 3rd) ed. of Sp. Pl.]. Thus, DeCandolle was evidently confused and thought that Miller's name was based on *H. racemosus* L.; that he did not equate Miller's name with *H. muscari* (as he should have) is clear from his citation (op. cit., p. 207) of the latter under his *M. ambrosiaceum* Moench, the odoriferous species (our "musk-hyacinth").[7]

Since the name *Muscari racemosum* is unavailable for the common grape-hyacinth, a taxonomic judgment must be made as to what other name, if any, in the literature is applicable to this species. Pending the monographic work which this genus needs, the appropriate name seems to be *M. atlanticum* Boiss. & Reut. (Pugill. Pl. Nov., p. 114. 1852). This name was taken up by Dandy (List Brit. Vasc. Pl., p. 599. 1958), who has been followed by Clapham, Tutin, & Warburg (Fl. Brit. Isles, ed. 2, p. 975. 1962).

Polygonatum commutatum (Schult. f.) A. Dietr.

P. canaliculatum Auct., non *Convallaria canaliculata* Muhl. *ex* Willd.

This synonymy was worked out by R. Ownbey (Ann. Missouri Bot. Gard. 31: 393 & 403. 1944) and I am unaware

[7] I am greatly indebted to W. T. Stearn of the British Museum for his help in clarifying this problem (in litt., 1961).

of any reason not to accept her conclusions, although Fernald did not do so in Man., ed. 8.

Smilax ecirrata (Kunth) Watson

The usual spelling *S. ecirrhata* is given as a "bad example" of word construction by R. W. Brown (Composition of Scientific Words, p. 245 [& cf. p. 4]. 1954). It happens, however, that this is a bad example of a bad example. The original spelling was correct [*Copromanthus herbaceus* β *ecirratus* Engelm. ex Kunth, Enumerat. 5: 266. 1850] and there was no reason for Watson in assuming specific rank (Man., ed. 6, p. 520. 1889) or anyone else to adopt an inferior spelling.

IRIDACEAE

Sisyrinchium angustifolium Mill.

The nomenclature of *Sisyrinchium*, especially revolving around this name, is no less complicated than its taxonomy. Both have been carefully investigated by Dr. Daniel B. Ward, whose results are not yet published, so it is premature here to concur in his work, which has seemed sensible insofar as I have been aware of it. Thus postponing this large problem, I confine myself to a comment concerning a Michigan species:

Sisyrinchium farwellii Bicknell

This is noted by Fernald (Man., ed. 8, p. 458. 1950) as "scarcely separable" from *S. arenicola* Bickn. (Bull. Torrey Bot. Club **26:** 496. 1899). One fears that the reason for Fernald's reluctance to state directly that they are the same is that *S. farwellii* (Bull. Torrey Bot. Club **26:** 298. 1899) has a few months' priority and hence the familiar name for the eastern coastal species would have to be abandoned. In any event, Michigan plants (only the distinctive type collection is known) must be called *S. farwellii*, whether or not the coastal ones are different. *Sisyrinchium farwellii* differs in several important characters from *S. atlanticum* Bickn., of which for some reason Alexander (in Gleason, Ill. Fl., **1:** 452. 1952) considered it only a form.

ORCHIDACEAE

Calopogon tuberosus (L). BSP.

C. pulchellus (Salisb.) R. Brown

Manuals continue to use Brown's illegitimate name in spite of a clear elaboration of the case by Mackenzie (Rhodora 27: 193-196. 1925), whose opinion is apparently accepted by Rickett & Stafleu (Taxon 8: 257. 1959).

Corallorhiza trifida Chatelain

In 1907, Rendle and Britten (Jour. Bot. 45: 442) called attention to the fact that the earliest valid publication of the generic name *Corallorhiza* was by J. J. Chatelain (Specimen Inaug. Corall., 1760). This fact was reiterated by Fernald in 1946 (Rhodora 48: 193). In 1909, Ames (Rhodora 11: 106) made no mention of the correct citation of the generic name but did state (as had Rendle & Britten, whom he did not credit with the discovery) that since an inadmissible tautonym would result from the transfer of *Ophrys corallorhiza* L. to this genus, the valid name for the plant previously known as *C. innata* R. Br. (1813) must be *C. trifida* Chat. (1760).

In the meantime, apparently no one has questioned taking up *C. trifida*. The generic name may, of course, validly date from Chatelain's work even if his specific names are for any reason to be rejected.

In his little 15-page paper, Chatelain accepted two species of *Corallorhiza*. "Species Prima" is "Corallorhiza nectarii labio trifido" with the marginal epithet "Trifida," as reprinted by Ames (loc. cit.). "Species Secunda," which has not been mentioned by those who have called attention to Chatelain's previously neglected paper, is "Corallorhiza nectarii labio integro," with no trivial epithet indicated in the margin. *C. ruppii* Hall. is cited as a [pre-Linnaean] synonym. Among the synonyms cited for C. nectarii labio trifido is the Linnaean polynomial (but not the Linnaean epithet, under *Ophrys*, of *Corallorhiza*).

From this evidence, and knowing the reluctance of Haller (for whom Chatelain's publication was a doctoral dissertation) to accept binomial nomenclature wholeheartedly, we might seriously wonder whether this may not be a work

"in which the Linnaean system of binary nomenclature for species was not consistently employed" (Art. 23). One species has a binomial; the other does not.

The consequences of such a conclusion can probably be avoided. Either we can consider that Chatelain in his "Species Secunda" was validating *C. ruppii* of Haller, or we can assume that a trivial epithet *integra* was accidentally omitted from the margin. The latter suggestion is supported by the first sentence of his concluding paragraph: "Ex descriptione data Corallorhizae integrae, à trifida discrepare videtur, in eo, quod nectarii labium integrum sit." Apparently he did intend that his second species be known as *Corallorhiza integra*.

This second species is presumably not taxonomically distinct from *C. trifida* as now understood and generally considered to be the only European representative of the genus. So whatever Chatelain intended to call it, the rule (Art. 57) of the "first reviser" (Rendle & Britten?) would cause us to accept *C. trifida* over the other name of the same date. No name *C. integra*, nor any other epithet of Chatelain's except *trifida*, has been listed in the Index Kewensis, which finally caught up with *trifida* in the Fifth Supplement, and which still (11th suppl.) credits the genus (spelled "Coralorrhiza" to Robert Brown.

I do not propose to abandon the now familiar name *C. trifida*. But for consistency, if we assume that Chatelain did use binary nomenclature (thus validating *trifida*), his other species, even though undoubtedly a taxonomic synonym, should be properly indexed and accepted as validly published.

Cypripedium × andrewsii Fuller

Garay (Science 148: 65. 1965) has criticized the use of *C.* × *andrewsii* in Case's "Orchids of the Western Great Lakes Region" (Cranbrook Inst. Sci. Bull. 48, col. pl. 2. 1964). It should be borne in mind that when our yellow lady-slippers are treated as a single species (usually with two varieties, as in Case), the hybrids, no matter of which variety, with *C. candidum* would under Art. H. 1 receive the same name: "Where binary 'specific' names of Latin

form are used for hybrids, all offspring of crosses between individuals of the same parent species receive the same binary name. . . . When polymorphic parental species are involved and if infraspecific taxa are recognized in them, greater precision may be achieved by the use of formulae than by giving the hybrids 'specific' names."

Without admitting that the Code adequately or clearly treats all problems in the nomenclature of hybrids, there would seem to be a good case for accepting *C.* × *andrewsii* Fuller (Rhodora 34: 100. June 3, 1932) over the slightly later *C.* × *favillianum* Curtis (Rhodora 34: 242. Dec. 14, 1932). Into the same synonymy would fall the backcross *C.* × *landonii* Garay (Canad. Jour. Bot. 31: 660. 1953). (Cf. Boivin, Nat. Canad. 87: 32. 1960.)

Orchis rotundifolia Pursh f. **lineata** (Mousley) E. G. Voss, *comb. nov.*
O. rotundifolia var. *lineata* Mousley, Canad. Field-Nat. 55: 65. 1941.

Only formal rank seems appropriate for this striking variant, which was originally described from Alberta and later discovered in Ontario.[8] The albino form of this species was named *O. rotundifolia* f. *beckettii* Boivin (Nat. Canad. 87: 42. 1960); since it is named for the industrious and amiable Mrs. Eva Beckett (formerly of Churchill, now of Fort William), the spelling should be corrected to *beckettae* (Art. 73, Note 3 & Rec. 73C).

Spiranthes lacera (Raf.) Raf.

In 1946 Fernald pointed out (Rhodora 48: 6 et sqq.) that *S. lacera* (Raf.) Raf. (based on *Neottia lacera* Raf., 1818) would have priority over *S. gracilis* (Bigel.) Beck (based on *Neottia gracilis* Bigel., 1824). However, Fernald found

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[8]Elliott (Rhodora 62: 174. 1960) reported this form from Sibley Provincial Park, on the north side of Lake Superior. Unaware of his discovery, on July 22, 1961, Robert L. Jeanne and I discovered this form to be local in a black spruce — sphagnum bog at the head of the north arm of Fork Bay, at the southeast end of the Sibley Peninsula. The lip was white, streaked longitudinally with bold purplish lines becoming confluent. The normal form with spotted lip was also in the area. Specimens of f. *lineata (Voss 10203)* have been distributed to the herbaria of the University of Michigan, University of Toronto, the author, and Sibley Provincial Park.

it unnecessary completely to supplant *S. gracilis*, determining that it applies to a predominantly southern species whereas *S. lacera* applies to a more northern species not previously distinguished by most authors.

Most subsequent authors have also not been able to distinguish the two (e.g., Correll, Nat. Orch. N. A., p. 197. 1950; Gleason, Ill. Fl. **1:** 470. 1952). However, they have neglected Fernald's original point that *S. lacera* has priority over *S. gracilis.* Our northern plant, in any event, is to be called *S. lacera* (Raf.) Raf. Those who find the southern population different may call it *S. gracilis* (Bigel.) Beck; otherwise, they must call it, too, *S. lacera.*

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NOTES ON LESSER ANTILLEAN FERNS. II

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Continuing studies on the Pteridophyte flora of the Lesser Antilles have revealed further taxonomic problems to be solved, and a few more undescribed populations of ferns which require names. The present paper is a sequel to one published in Rhodora in 1961 (vol. 63, pp. 31-35), and arises largely from studies made at the Harvard University herbaria during September and October, 1965, supported by a Mercer Research Grant from the Arnold Arboretum which is gratefully acknowledged.

Special thanks are due to Dr. Robert C. Foster for his preparation of the Latin descriptions of new taxa.

LYCOPODIACEAE

Lycopodium reflexum Lam. var. **rigidum** (J. F. Gmel.) Proctor, comb. nov., based on *Lycopodium rigidum* J. F. Gmel. in L., Syst. Nat. ed. 13, 2: 1289. 1791. This variety typically differs from var. *reflexum* in its more rigidly ascending leaves with less strongly denticulate margins (sometimes nearly entire), and in its slightly larger sporangia. It has usually been treated as a species distinct from *reflexum*, but considerable intergradation occurs, and I suspect that some of the differences may be due to the influence of varying growth-conditions; var. *rigidum* usually grows at relatively higher elevations in more exposed situations.

HYMENOPHYLLACEAE

Hymenophyllum hirtellum Swartz was not credited to the Lesser Antilles by Morton (Contr. U.S. Nat. Herb. **29**: 164-165. 1947) in his treatment of the group to which this species belongs. Subsequently, Kramer (in Stoffers, Fl. Neth. Ant. **1**: 19-20. 1962) attributed *H. hirtellum* to several Lesser Antillean islands. The material on which Kramer's records were based is apparently equivalent to *Hymenophyllum gratum* Fée, more recently (Brit. Fern

Gaz. 9: 73. 1962) reduced to varietal status under *H. hirsutum* by the present writer.

It must be conceded that *Hymenophyllum hirtellum* in its typical form is confined to the Greater Antilles. A closely related population occurring in Guatemala was assigned specific rank *(H. maxonii)* by Morton, and the Lesser Antilles material somewhat resembles that taxon, even to the occurrence of two rather well-marked varieties similar to those of *maxonii.* However, the Lesser Antilles plants differ from their Guatemalan counterparts in subtle differences of texture, particularly in the somewhat coarser hairs on the fronds, and the wide geographic disjunction suggests that the two populations evolved separately, perhaps from the same stock as the present Greater Antillean *hirtellum.*

In assigning names to the Lesser Antilles material, several alternative courses are possible. One of these is to recognize the species *H. gratum* Fée, and then to subdivide this into two varieties. Objections to this course are the apparent intergradation toward typical *H. hirtellum* shown by certain specimens, and the difficulty of clearly distinguishing *gratum* from *maxonii* on a morphological basis. Another course is to relate *gratum* directly with *maxonii,* but this is objectionable on phyletic grounds. The course adopted is to regard the Lesser Antilles populations as geographic varieties of *H. hirtellum.*

Hymenophyllum hirtellum Swartz, var. **gratum** (Fée) Proctor, comb. nov., based on *H. gratum* Fée, Mém. Foug. 11: 118, *t.30, f1,* 1866. *H. hirsutum* var. *gratum* (Fée) Proctor in Brit. Fern Gaz. 9: 73. 1962. The assignment of this taxon as a variety under *H. hirsutum* was due to the close resemblance of some forms to that species, but the very much larger size and convergence with *H. hirtellum* now suggests that the latter species probably has a closer relationship.

Hymenophyllum hirtellum var. **vincentinum** Proctor, a varietate typica frondibus laxe pendentibus, laminis linearibus vel lanceolinearibus, ad 27 cm. longis, plerumque 3-4.5 cm. latis (raro ad 6 cm.); stipitibus peranguste marginatis, non alatis, soris 1.2 mm. latis non excedentibus differt.

TYPE from southeast slopes of the Soufrière volcano, St. Vincent,

in mossy woodland (*Proctor 25987*, IJ, isotypes A, U, USF), collected 26 Feb. 1965.

Numerous other specimens of this entity have been seen from St. Vincent, where the population is quite uniform and distinct. It is connected with var. *gratum*, however, by intermediate forms occurring especially in St. Lucia, but also from several other islands.

POLYPODIACEAE

Diplazium legalloi Proctor, sp. nov. *Asplenium callipteris* sensu W. Hook. & Bak., Syn. Fil. 231. 1867, in part; Duss, Foug. & Lyc. Ant. Fr. 85. 1903, not *Diplazium callipteris* Fée, 1852.

Rhizoma erectum, apice squamis pallide brunneis, ovatis, lacerato-fimbriatis vestitum. Frondes ad 1.7 m. longae, vel ultra, crassae, coriaceae. Stipites ad 60 cm. longi, alte sulcati, basin versus squamati, sparse appresseque arachnoidei. Laminae ovato-oblongae saepius plus quam 1 m. longae, ad 60 cm. latae; rhachis alte sulcata in partem superiorem. Pinnae 9-11 pares, lanceo-oblongae, 12-30 cm. longae, 5-10 cm. latae, inferiores breve stipitatae, apicibus acutis vel subfalcatis, marginibus subintegris vel sinuato-crenatis (raro late truncato-lobatis); atro-virides, supra glabrae, infra sparse appresso-pilosae. Venae prominulae, in fasciculis, pinnato-ramosae, curvato-conniventes ad margines subcartilaginei. Sori elongati, ad 3 cm. longi; indusium augustum, atrobrunneum, lacerato-ciliolatum.

TYPE from the vicinity of Ravine Chaude, above Matouba, Guadeloupe (*Proctor 20164*, A, isotype IJ), collected Nov. 26, 1959, in the company of Père C. LeGallo, for whom the species is named.

Père LeGallo, for many years stationed at the Roman Catholic church of Vieux Fort, Guadeloupe, has a wide botanical knowledge of this and other islands, has collected extensively (especially mosses), and is a worthy member of the long and distinguished line of French priest-botanists who (beginning with Charles Plumier) have contributed much to our knowledge of Antillean plants.

The species now described as *Diplazium legalloi* has long been known as *D. callipteris* Fée. The latter name, however, was based on *Linden 233* (ascribed by Fée to Cuba in error), which originated in Venezuela and represents the plant known by the earlier name *D. celtidifolium* Kunze. Fée himself misidentified the Guadeloupe plant in his treatise on Antillean ferns (1866), as his illustration *(t.10, f.2)* makes clear. *D. legalloi* differs from *D. celtidifolium* in its

usually wider pinnae of a different shape and texture, in the longer sori with lacerate-ciliolate (instead of entire) indusium, and in other details.

Diplazium limbatum (Willd.) Proctor, comb. nov., based on *Asplenium limbatum* Willd. in L., Sp. Pl. **5:** 310. 1810, *Asplenium marginatum* L., Sp. Pl. **2:** 1082. 1753; *Hemidictyum marginatum* (L.) K. B. Presl; *Diplazium marginatum* (L.) Diels, not Blume, 1828.

There are no convincing characters by which *Hemidictyum* can be maintained as distinct from *Diplazium*, but under the latter genus a different specific epithet is necessary.

Elaphoglossum petiolatum (Swartz) Urban, var. **dussii** (Underw. ex Maxon) Proctor, comb. nov., based on *Elaphoglossum dussii* Underw. ex Maxon, Pter. Porto Rico 398. 1926.

Grammitis phlegmaria (J. Sm.) Proctor, comb. nov., based on *Polypodium phlegmaria* J. Sm. in London Jour. Bot. 1: 194. 1842.

Grammitis phlegmaria var. **antillensis** Proctor, var. nov. *Polypodium flabelliforme* sensu Griseb., Fl. Br. W.I. 700. 1864, not Poir. in Lam., 1804.

A varietate typica in segmentis angustioribus oblongibusque, marginibus subintegris (non pergibbosis et sinuato-crenulatis), rhizomatis squamis latioribus clathratioribus, griseo-brunneis (non luteo-bruneis) differt.

TYPE from along Trace Victor Hugues near Grande Découverte, Guadeloupe (*Proctor 20307*, IJ), collected Dec. 8, 1959. Known also from Dominica, Martinique, St. Vincent, and Grenada. Typical *G. phlegmaria* is chiefly a plant of northern South America. True *Polypodium flabelliforme* is an older name for *P. rigescens* Bory ex Willd., and originated from the island of Réunion.

Grammitis stipitata Proctor, sp. nov.

Subg. *Melanoloma*. Rhizoma breve, decumbens vel erectum; squamae attenuati-deltateae, ad 3 mm. longae, ochraceo-brunneae, subclathratae. Frondes fasciculatae, in textura firmae, longe stipitatae; stipites 4-6 cm. longi, sursum anguste marginati, hirtelli in toto, pilis brevibus, patentibus, pluricellularibus. Laminae anguste lanceo-lineares vel lanceatae, 8.5-14 cm. longae, ad 1.3 cm. latae infra medium, ad apicem anguste acutae, ad basim cuneatae, nervo primario infra et marginibus atro-scleroticis sparse hirtellis sicut in stipite. Venae plus minusve 1-2-furcatae, liberae vel paucae ad apices conjunctae, margines non attingentes; sporangia glabra.

TYPE from Guadeloupe without definite locality (*E. A. Marie 6*, P, isotypes BM, IJ, NY).

Although known only from the type collection, this species appears to be absolutely distinct. Copeland (in Phil.

Jour. Sci. **80**: 258. 1952) mentioned it merely "as an abnormal form of *G. limbata*", but it clearly differs from the latter in its larger, long-stipitate fronds, forked and occasionally anastomosing veins, and hispidulous margins. It seems much more nearly related to *G. marginella*, but aside from the elongate stipes, the fertile veinlets are not prolonged beyond the sori as they are in that species.

Thelypteris consimilis (Fée ex Bak.) Proctor, comb. nov., based on *Gymnogramma gracilis "β, G. consimilis"* Fée ex Bak. in W. Hook. & Bak., Syn. Fil. 377. 1868. *Dryopteris consimilis* (Fée ex Bak.) C. Chr., 1907, as to name. *D. mollicella* Maxon in Proc. Biol. Soc. Wash. **36**: 49. 1923. TYPE from Guadeloupe, *L'Herminier*.

It has been customary to place the name *consimilis* in the synonymy of *Thelypteris gracilis*, but in the present writer's opinion these are distinctly different species, as shown particularly by the structure of the hairs. No material of true *T. gracilis* has been seen from the Lesser Antilles.

It should be noted that in Morton's recent treatment of West Indian *Thelypteris* with "red" glands (in Amer. Fern Jour. **53**: 57-70. 1963), this species was omitted. In his key, it would come out to *T. piedrensis*, from which it differs in shape of pinnae and especially in having the lower surfaces rather densely puberulous with hamate hairs; in *T. piedrensis*, underside hairs are practically confined to the vascular parts, and are coarser and always acicular. The latter species is apparently known only from Cuba and Puerto Rico, according to available records.

Thelypteris cooleyi Proctor, sp. nov.

Subg. *Thelypteris*. Rhizoma erectum, 0.4-1 cm. crassum, ad apicem squamis numerosis, lucidis, brunneis, lanceo-attenuatis, minute glandulosis vestitum. Frondes fasciculatae, in textura elasticae. Stipites comparate perbreves, 1.5-5 cm. longi, minute stipitato-glandulosi, cetera glabri. Laminae oblanceatae, 20-75 cm. longae, 7-15 cm. latae, acuminatae, deorsum longi-attenuatae, pinnis infimis distantibus, auriculiformibus; rhachis straminea, pars superior bifariam minuteque cincurvo-puberula, cetera glabra. Pinnae plerumque 25-35 pares, oppositae, anguste lanceo-lineares, subaequilaterales, ad basin sessiles 5-15 mm. latae (pinna aerophora parvo, conico subtenta), ad apicem attenuato-falcatae, alte pinnatifidae, glabrae. Segmenta subobliqua, deltato-oblonga, plerumque ad basin 2-3 mm. lata, acuta; segmentum infimum acroscopicum pinnae plerumque dilatatum, ovatum, rhachidem excessum, venis furcatis et marginibus serratis; venae segmen-

torum plerumque in paribus 4-6, simplices; margines segmentorum fertilium plerumque revolutae, soros in parte obscurantes. Sori submarginales; indusium rotundato-reniforme, ca. 0.8 mm. latum, rufobrunneum, minute stipitato-glandulosum, persistens; sporangia glabra.

TYPE from outer slopes and rim of the Soufrière crater, St. Vincent (*Proctor 26008*, IJ, isotypes A, U, US, USF), collected 26 Feb. 1965 in company with Mr. George R. Cooley, for whom the species is named in recognition of his contributions to West Indian botany. Paratypes (all from St. Vincent) *Cooley 8214, 8417, 8445*, and *8591;* also *Proctor 25985.*

Thelypteris cooleyi is closely related to *T. limbata* (Sw.) Proctor, but differs from the latter in its narrower fronds always of clearly definite growth, in its glandular rhizome-scales whose cells are smaller and less transparently clathrate, in its entire ultimate segments, with the sori not located on teeth, and in its much paler indusium. Further, the tissues of *T. limbata* are characteristically beset with reddish or yellowish, sessile, resinous glands on the underside, while such glands are entirely absent from *T. cooleyi.*

INSTITUTE OF JAMAICA,
KINGSTON, JAMAICA

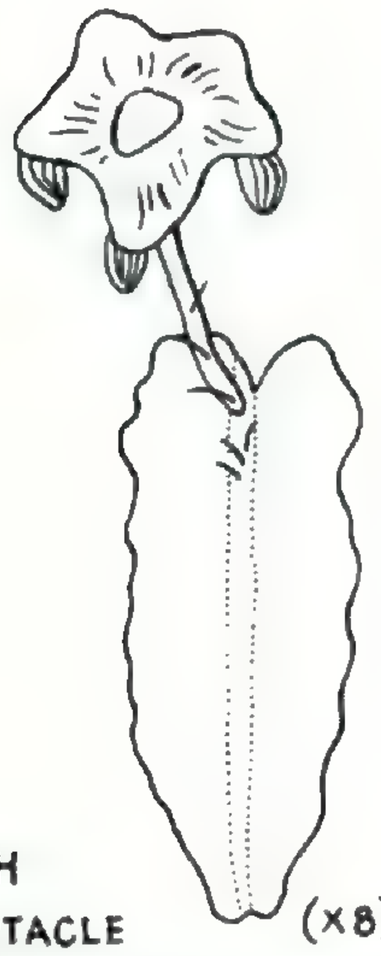
A NEW SPECIES OF ASTERELLA FROM MEXICO

R. M. DEL ROSARIO[1]

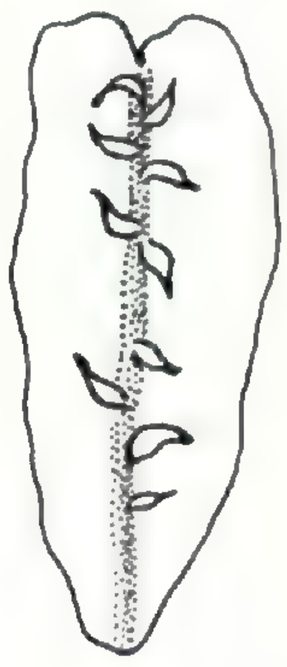
Asterella evansii del Rosario sp. nov. Monoica et tenuis frequenter viridis omnino sed interdum tincta purpureo, praesertim in superficie ventrali. Thalli usque ad 15 mm. longi, 4 mm. lati, ramificantes furcalis, interdum simplicibus ex apice innovatis aliquando praesentibus. Thalli plani vel parvo concavi cum margine crispato et parvo sinuato. Cellulae epidermidis cum tenuibus parietibus sed interdum cum aliquantum distinctis trigonis. Stomata 80-90 μ longa et 65-80 μ lata, circumventa 6-7 seriebus cellularum, cum 3 cellulis in quibusque seriebus et cum radialibus parietibus parvo crassatis aliquantum distinctis minutisque trigonis. Squamae ventrales aliquantum purpureae et interdum hyalinis, subulatis et inconstricto basi, acutis usque ad acuminatis, totis vel aliquantum dentatis. Pedunculus cum sparsis paleis tenuibus et parvo confertiore fasciculo in apice, viridosus sed interdum purpurarius usque ad fuscasus basi, circa 1 cm. altitudine. Carpocephalum lanum vel fere planum cum parva media parte parvo elatiore, cum inferis et salebrosis tuberculis; involucra dubie sinuata-crenata, vix attingentia margines loborum. Pseudoperianthia alba vel sufflava et interdum tincta purpureo et directa in obliquum desuper. Sporae fulvasae, 60-80 μ diametro cum tota superficie tecta subtile et incomposito reticulo cum retiaculis 1-8 μ latis. Sporae minute punctulata. Elateres fulvosi, 200-500 μ et 8-10 μ lati, etiam plurime bispirales omnino.

Thalli 0.5-1.5 cm. long, 1.5-4 mm. wide, thin, usually green throughout but sometimes more or less tinged with purple, the pigmentation usually more extensive in the ventral surface, branching by forking, sometimes simple, apical innovations sometimes present, plane or slightly concave, with slightly sinuate crispate margins, not incurved when dry, keel broad and rounded. Epidermal cells averaging 40-60 μ, with thin walls but sometimes with more or less distinct trigones, cells containing oil bodies 10 or fewer, scattered. Pores slightly elevated, 80-90 μ in length, and 65-80 μ in width, surrounded by 6-7

[1]Philippine National Herbarium, National Museum, Manila, I wish to express my appreciation to Dr. Ronald L. McGregor, head of the Botany Department, University of Kansas for his suggestions and criticisms. To the curators of the herbaria of New York Botanical Garden and U. S. National Museum, I am indebted for the loan of specimens. I must also extend my thanks to the National Museum of the Philippines and the University of Kansas whose financial aid made possible this study. To Prof. Austin Lashbrook, Classics Department, University of Kansas, my sincere thanks for editing the Latin diagnosis.



THALLUS WITH FEMALE RECEPTACLE (X8)



THALLUS IN VENTRAL VIEW (X8)

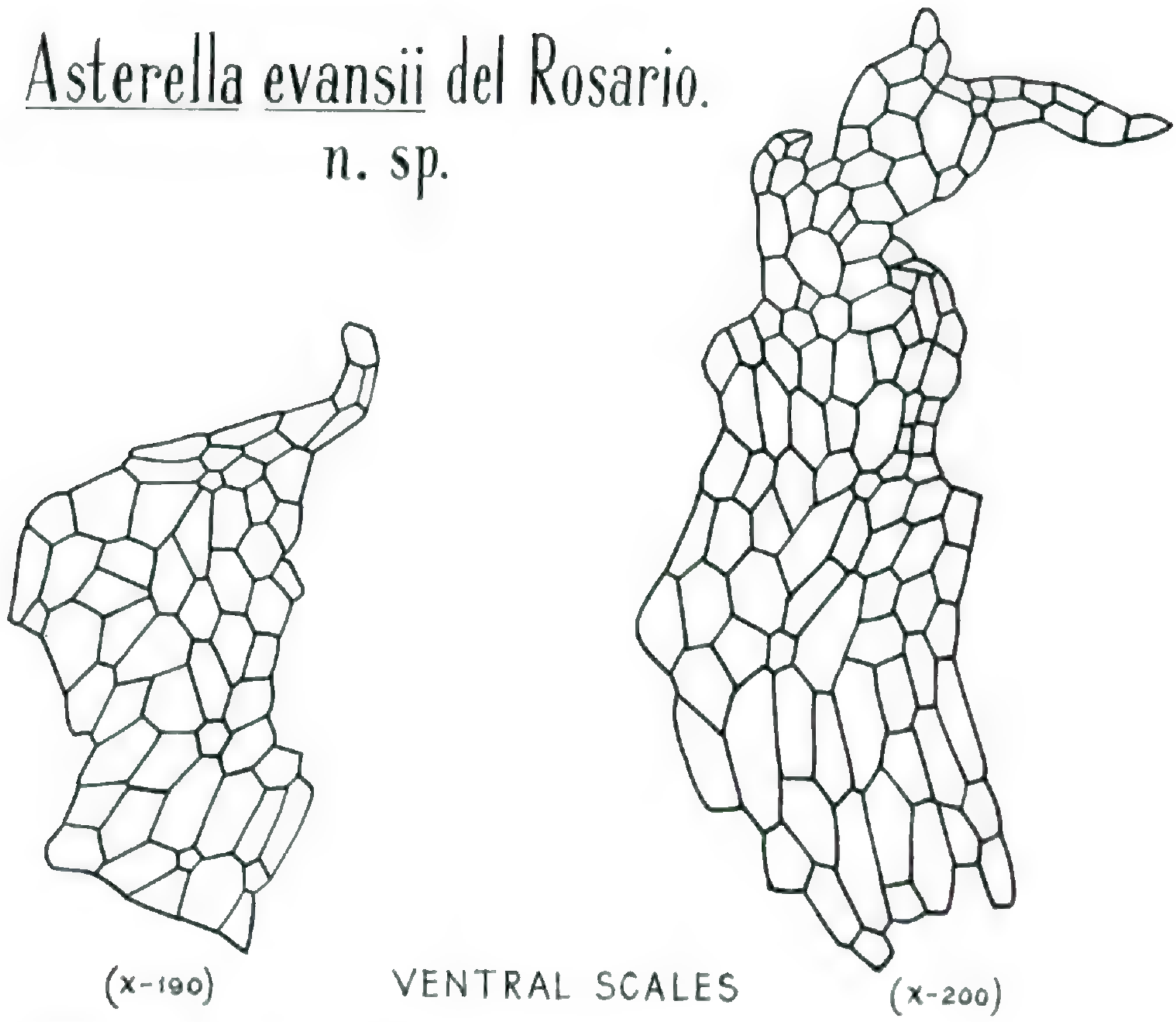
Asterella evansii del Rosario, n. sp.

series of cells with 3 cells in each series, radial walls slightly thickened with more or less distinct trigones. Green tissue loose, air chambers sparingly subdivided by supplementary partitions. Ventral tissue composed of cells with thin unpitted walls. Ventral scales more or less purple, sometimes with hyaline margins and appendages, with 10 or fewer oil bodies, appendages 1-2 subulate from an unconstricted base, 0.25-0.4 mm. long and 0.12-0.18 mm. wide, acute to acuminate, entire or somewhat dentate with occasional oil bodies in the ventral portion. Paroicous; the antheridia forming a small and irregular median group near the peduncle of the female receptacle, the ostioles low. Peduncle with scattered slender paleae and a slightly denser cluster at the apex, greenish but sometimes purplish to brownish at base, about 1 cm. high. Disk of receptacle, 3-4 mm. wide, flat or nearly so, with a small slightly elevated center, with low but coarse tubercles, rugose when dry, normally 4-lobed, the lobes spreading almost horizontally, the involucre vaguely sinuate-crenate, barely reaching the margins of the lobes. Pseudoperianth white or yellowish, sometimes pigmented with purple, directed obliquely downward, 8-10-cleft, the divisions narrowly lanceolate, connate at apex, operculum remaining intact at dehiscence. Spores yellowish-brown, 60-80 μ in diameter, with wavy crenulate wings, 8-14 μ wide along the edges, the entire surface covered over with a fine and irregular reticulum, the meshes 1-8 μ wide, the surface, in addition, minutely punctulate. Elaters yellowish-brown, 200-250 μ and 8-10 μ wide, variously coiled, mostly bispiral throughout.

Growing on banks. Distribution: Mexico. Type locality: Cañada Santa Magdalena, Mexico.

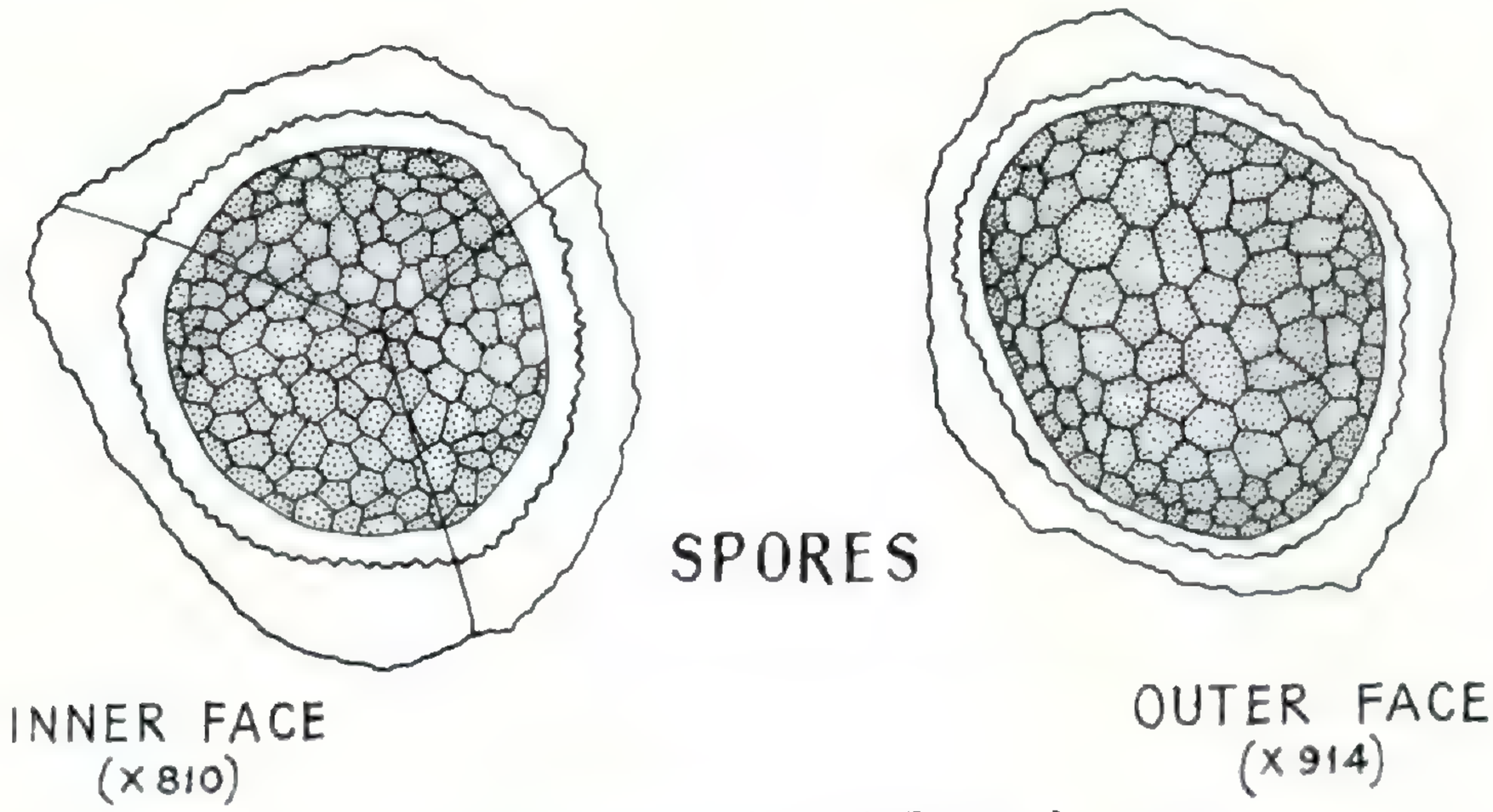
SPECIMENS CITED — Cañada Santa Magdalena, 1908, *Barnes and Land 441* (NY, holotype, mixed with *Targionia hypophylla* L.);

Asterella evansii del Rosario. n. sp.



Amecameca, 1908, *Barnes and Land 339* in part (NY, mixed with *Targionia hypophylla* L.); banks along Avenida Hidalgo and path to Teziutlan, Puebla, *Barnes and Land 555* (NY).

Since 1920, the specimens of this new species have been identified as *A. venosa*, in spite of the fact that the characteristics of their epidermal pores, ventral scales, and spore markings differ from those of the latter species. Evans (1920) was unable to study the type of *A. venosa*. Its distinguishing characteristics which were listed in an annotation made in 1956 are as follows: The radiating series of cells around the pores are 4-6 and the radial walls are not thickened. The appendages of the ventral scales are constricted in the base and the tip is blunt or obtuse with one or two apical cells. In general, the cells of the appendages are globose and do not have oil bodies. The meshes of the spores are larger, 10-24 μ in diameter. On the other hand, in the new species, *A. evansii*, the radiating series of cells around the pores are 6-8 and the radial walls are thickened. The appendages of the ventral scales are apicu-



Asterella evansii del Rosario, n.sp.

lated, unconstricted at the base and have oil bodies. The meshes of spores are much smaller, being 1-8 μ wide.

There is another specimen identified also as *A. venosa* which was collected in Venezuela by Chardon in 1932. I determined this specimen as *A. macropoda,* which is a South American species. Its distinguishing characteristics are a larger thallus with lateral intercalary branches, larger epidermal pores, autoicous inflorescence, larger disk of female receptacle, and yellowish-brown pseudoperianth, and 12-16 cleft. The spores are immature but the characteristic brown color is well shown. *A. macropoda* has coarsely reticulate spores 20-30 μ in diameter.

Thus, *A. venosa* is again restricted to Brazil with possible occurrence in other parts of South America. The extension of the range of this species to Mexico was mainly based on the specimens described above which, as said earlier, were incorrectly determined.

A. evansii is named after the late Alexander W. Evans who was the leading authority on the genus in North America.

PHILIPPINE NATIONAL HERBARIUM
NATIONAL MUSEUM, MANILA

LITERATURE CITED

Evans, A. W. 1920. The North American Species of *Asterella,* Contr. U. S. National Herbarium **20**: 286.

RUBUS SUBGENUS EUBATUS IN NEW ENGLAND
A CONSPECTUS[1] [2]

A. R. HOGDON AND FREDERIC STEELE

This paper is an attempt to define the species of blackberries in New England, to produce a workable key, and to assess the previous work on the group in our area. It is not intended to be a monographic treatment, as no attempt has been made to survey the subgenus throughout its entire geographic range. It is rather a provisional treatment for the New England area. *Rubus* is an inherently difficult genus, as the different species intergrade in a perplexing manner. More cytotaxonomic and genecological information is needed before a definitive treatment can be made. Nevertheless, 15 years of field study have convinced the authors that there are evolutionary populations that can be treated as species by competent botanists in the field, or in the herbarium, providing there is adequate data. Although we feel that our species are "good," further research, especially on hybridization and introgression, might reduce the number slightly.

The first major step in taxonomy certainly must be to establish a reasonable assemblage of taxa that are well enough defined to permit botanists to communicate facts and ideas about them. This premise appears so reasonable that it should not be necessary to mention it at this time. However, our blackberries have become essentially unworkable taxonomically largely through the reliance of authors solely on morphological criteria for the interpretation of species. As a result the circumscriptions of new taxa have been related to single specimens rather than populations. There has resulted a multiplicity of "species" a large pro-

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portion of which have no validity in evolution as such and actually are expressions of intraspecific variation or else are interspecific hybrids of many kinds. Hodgdon and Steele (1962) showed that glandularity in *Rubus alleghen-iensis* is a very variable character which makes it difficult to separate other "species" from *R. alleghen*iensis on grounds of glandularity. More recently Steele and Hodgdon (1963) demonstrated that a number of so-called species could be referred to hybrids of *Rubus hispidus* and *R. setosus*. A large number of field observations and laboratory measurements support our belief that nearly all of our species of blackberry hybridize in nature. Also it is quite apparent that there is much intraspecific variability throughout most of the group involving such characters as the type of inflorescence, the quality and number of prickles and bristles, the stature and growth habit, as well as glandularity. Apomixis is a further complicating factor in the taxonomy of blackberries. In Europe Gustafsson (1946, 1947a, b) showed that *Rubus fruticosus L.*, considered as a collective species, contained both amphimictic and apomictic lesser taxa, the apomixis often being facultative. Commenting on the implications of apomixis in taxonomy Valentine & Löve (1958) wrote, "In many apomictic groups, very large numbers of species have been described taxonomically: the fact that each individual may be true-breeding means that discrimination can be much finer than in the amphimictic groups. As demonstrated by Gustafsson (l.c.), the resulting classifications vary a great deal in their usefulness and validity. Once a taxonomist dealing with a particular group has decided on his criteria he must maintain them; and in apomictic groups, this may lead to the description and naming of very many species which are very local or even ephemeral."

Einset (1951) worked with 24 "different forms of Rubus" determined by L. H. Bailey and grown at the New York State Agricultural Experiment Station at Geneva, New York. The chromosome numbers of parent plants were determined and various pollinations were tried. Einset then grew seedlings and made chromosome counts of these. He

found that from 80-100% of the progeny resulted from the parthenogenetic development of unreduced eggs. He concluded that the principal type of apomixis occurring was pseudogamy with the unreduced eggs developing parthenogenetically. He noted also that some hybrid offspring were produced, indicating facultative apomixis.

Vegetative spreading also may take place in blackberries with great rapidity. Considerable areas thus can be occupied by populations, depending on the length of time involved and barriers to spreading. With the fragmentation of such colonies a single clone may come to occupy a sufficiently extensive area in such a way as to suggest that it be recognized as a distinct "species" in the flora.

It is evident to us that the "species" that have been described, variously fit all the categories discussed above; some are "good species", some are better treated as falling within the range of variations of these "species", others are recognizable hybrids between these "good species" while still others are more obscure populations whose status is yet quite uncertain. Until the biological nature of these populations can be ascertained we are not ready to accord the lesser ones taxonomic status. The fact that many of these populations will be shown to be of hybrid origin and are thus distinct and that they tend to produce essentially similar offspring by apomixis or vegetative spreading, does not mean to us that they should be regarded as species. However distinct the hybrid population may have been when it first appeared, we don't consider it to be a species unless it has undergone subsequently a recognizable amount of evolutionary change. Such change is expressed in the development of evident and distinct morphological characteristics and those adaptive traits which permit the population to occupy a definite geographic range.

Our work on *Rubus* started with an attempt to compile a list of species for New Hampshire. At one time there was much interest in creating hybrids of horticultural value in *Rubus* at the University of New Hampshire under the direction of the late Dr. Albert F. Yeager. Several phases of research were completed which are of interest to taxono-

mists. One by Dr. Donald Craig (1959) related to our present study. It demonstrated that *R. canadensis*, a triploid, could be crossed with various blackberry cultivars.

At the beginning of our study we used the eighth edition of Gray's Manual expecting confidently to locate each species that Fernald attributed to New Hampshire. This soon led us to try out Bailey's elaborately presented studies in Gentes Herbarum (1932-49). Both treatments helped us make a start beyond which they became frustrating and, particularly true of Bailey, essentially unworkable. Because of the great prestige and massive productivity of both Fernald and Bailey we were too willing to accept their "species" without reservation but very soon we perceived that by relying solely on morphological criteria for "setting up" new species the end was by no means in sight, for if we wanted to add to the plethora of species, we too could proceed on the same basis and describe still more.

Our field studies and collecting have taken us throughout most of New England and also led us into parts of New Brunswick, Nova Scotia, and New York. The most significant omissions have been upper Maine, where there is reason to believe the number of species is relatively small, western Vermont and western Massachusetts. We have studied in the field and made collections of all indigenous species that we are recognizing in this treatment except *Rubus cuneifolius*. We have taken pains to make sure that all our collections of blackberries have careful descriptive notes on the growth-habit and include both primocanes and floricanes. To provide evidence of our research we have accumulated large collections of *Rubus* at the University of New Hampshire (NHA) and in Tamworth, N. H. (private herbarium of Steele).

Necessarily a considerable part of our work has been devoted to the study of herbarium specimens and particularly in recent years, to a careful evaluation of nomenclatural types. We wish to express our appreciation to the curators and staffs of the following herbaria which we have consulted, the Gray, Arnold Arboretum, and New England

Botanical Club herbaria at Harvard University, the Pringle Herbarium of the University of Vermont, the Jesup Herbarium of Dartmouth College, and the Bailey Hortorium collection of Cornell University. Bailey and Fernald set a high standard of collecting which often has been maintained by those who have come after them, but a very large proportion of the specimens in most herbaria are not subject to critical determination, since they are usually without habit notes and very often consist only of primocanes or floricanes, not both. Thus the value of these large collections in elucidating the taxonomic problems in the group is somewhat less than one might expect. Our principal approach has been the study of populations in nature and the collecting of much appropriate material followed by intensive herbarium study consisting of rather exact measurements of parts, the tabulation of results and the subsequent analysis of the population. One test of the validity of scientific work is predictability. Now with our background of experience in observing populations and analyzing them, when we enter a characteristic type of environment and find certain kinds of blackberries present, we can often anticipate finding the putative parents or hybrid offspring in the same general area.

Taxonomic work on *Rubus* subgenus Eubatus in New England in this century has been carried on by an interesting group of botanists. William Henry Blanchard (1850-1922) a farmer and country schoolmaster of southern Vermont described many species, amongst which we are recognizing the following in this paper: *R. recurvicaulis*, *R. arenicola*, *R. semisetosus*, *R. vermontanus* and *R. elegantulus*. Fernald (1950) accepted 19 additional Blanchard species. Several of these we interpret as rather commonly occurring hybrids having distinctive morphological features by which they can be recognized, *R. jacens* and *R. tardatus* for example.

Blanchard had a keen collector's eye but most of his specimens lack habit-notes. Also his method of collecting involved the grouping of several separate collections under

one collection number. This applies to types as well as to other specimens and make his specimens confusing to study. Bailey has selected lectotypes from Blanchard's "types" for most of the critical material.

Ezra Brainerd (1844-1924), also from Vermont, was at one time the President of Middlebury College and he had established a botanical reputation for his work on the genus *Viola*. His interest in blackberries largely was related to their breeding behavior and in fact his chief contribution was his recognition of the importance of hybridization in the group. With A. K. Peiterson (1920) he published a very interesting and suggestive paper on the subject. Essentially they recognized 12 basic species in New England which were postulated to have crossed and given rise to all the myriad of forms to be found in the area. Our chief criticism of their work centers around the inadequate evidence that was advanced to support their conclusions. A large part of the statements made about the parentage of their hybrids seem to be hypothetical and not proven. Also the taxonomic basis for the paper was faulty; for example they recognized *R. Baileyanus* Britt. which we have been unable to confirm and they failed to distinguish *R. recurvicaulis* Blanch. *(R. plicatifolius)* which we find to be fully distinct as a species.

A. K. Peiterson (1921) published a study of variation and hybridization in the blackberries. He performed transplant experiments to study the effect of environment on growth habit and armature. The indication was that plants grown in full shade were more erect than those in sun, the latter showing a marked tendency to trail. Primordial prickles and hairs were present on all blackberries. Their development is controlled by both genetic and environmental factors. In one experiment, suckers from the root of a plant grown in full sunlight produced many more prickles and glandular hairs than suckers from the same plant grown in shade. Infertility of blackberries, due to defective pollen, was found to be common. The two extremes, *R. alleghenien-sis* and *R. Baileyanus*, showed less infertility than any others possibly indicating that they were primitive species.

Many others may have been of hybrid origin. Eleven species were used in hybridization experiments and all crosses attempted were successful even though some species were remotely related. As a result of these experiments, Peiterson concluded, and the authors of this article concur, that hybridization is common in the Eubati and that a large number of so-called species are hybrids.

Although Peiterson's work was significant, he did not preserve voucher specimens of his crosses and it is difficult to know what the actual results were in terms of the species as we interpret them. Observations of herbarium material in the Pringle Herbarium at the University of Vermont indicate that several of Peiterson's species represent a varied assemblage of plants. For example any low blackberry of the Flagellares section may be designated as *R. Baileyanus* and any of three species may be designated as *R. frondosus*. It would be highly desirable to repeat the experiments preserving voucher specimens at all stages. Nonetheless had Bailey and Fernald accepted Brainerd's and Peitersen's explanation for the great diversity of blackberries as attributable to crossing, the study of *Rubus* subgenus Eubatus would probably have been brought into some order before now.

In Gray's Manual (1950) are to be found two species of Brainerd's, *R. severus* and *R. sceleratus* both of which are highly localized aberrant populations presumably of hybrid origin which we are not recognizing as species.

The name of Eugene P. Bicknell (1859-1925) must be introduced in relation to Blanchard and Brainerd. Bicknell (1910) published an article entitled "Have we enough New England Blackberries." He recognized 11 species including *Rubus flagellaris* Willd. which up to that time had not been interpreted properly. He accepted none of Blanchard's outpouring of species. Of the then recently published species of Blanchard and a few other newly named species proposed by other authors he made the following comment, "It would scarcely yet be the part of wisdom to accept any one of these new names as denoting a valid species nor, on the

other hand, is there sufficient warrant in our present knowledge for separating all of them as being without standing. I should suppose however, that some sixty per cent of the number might be allowed to pass into the category of synonyms; the remainder, possibly with a few exceptions, appear to disclose themselves as scarcely doubtful hybrids". It is ironic that Bailey (1941) named a species for Bicknell — a very localized blackberry of Nantucket which most certainly is of hybrid origin. Bailey concluded his remarks following the description of *R. Bicknellii* with the statement ". . . . ; his publication had much influence on the Rubus work of Rydberg and Brainerd". Yet Bicknell in the afore-mentioned discussion of New England blackberries had acknowledged Brainerd's influence in interpreting the great diversity of blackberries in York County, Maine as the result of hybridization.

Thus there were in the early years of this century two schools of thought concerning *Rubus* which have continued to the present.

Per Axel Rydberg (1913) tended to follow the conservative approach of Bicknell and Brainerd. However, for New England, he recognized 25 species, 12 of which we still maintain. He was more discerning than Bicknell in evaluating Blanchard's species: we find him accepting *Rubus vermontanus*, *R. arenicola* and *R. elegantulus*. He recognized *R. plicatifolius* of Blanchard which was published at the same time as was *R. recurvicaulis*, also Blanchard's *pergratus* which now is considered to be synonymous with Poiret's *pensilvanicus* and finally Blanchard's *recurvans* which we consider a state of *frondosus*. He followed the practice of Bicknell in listing the possible hybrids for each species. The difficulty with this approach to the problem of hybridization lies in its speculative quality; no evidence was provided and no specimens cited.

Liberty Hyde Bailey (1858-1954) did a prodigious amount of work on Rubus. He improved the terminology, devising such terms as primocane, floricane, parcifrond and novirame. He brought order and method to the study of the

group and he established an herbarium of the finest quality at Cornell University. Bailey proposed five of the seven native Sections of *Rubus* subgenus Eubatus that are often recognized in New England. These are Flagellares, Setosi, Cuneifolii, Canadenses and Alleghenienses. He provided a scholarly basis for further taxonomic work by clarifying types and designating them where necessary. His major treatments in Gentes Herbarum are clearly prepared and carefully illustrated. Because of the orderliness and completeness of his work it is easy to see his shortcomings. As pointed out by Steele & Hodgdon (1963) pp. 262, 263, Bailey refused to recognize hybridization as a taxonomic problem in blackberries. Also he paid scant attention to the variability within the species. Since there are no evident limits to variability in the group L. H. Bailey described hundreds of new species. Some of the folders at the Bailey Hortorium bear evidence that Dr. Bailey became confused at times; too often the other specimens in the folder fail to resemble the types. Bailey never accepted Blanchard's *Rubus elegantulus* although this is without doubt one of the most abundant and distinctive species throughout central and northern New England and eastern Canada. The only one of Bailey's species that we accept is *Rubus Jaysmithii* which is readily separable from its closest relative *R. flagellaris* by its pubescent leaves. Unless other distinctions can be found it may be better eventually to treat *R. Jaysmithii* as a lesser taxon.

M. L. Fernald (1873-1950) also made substantial contributions to our knowledge of *Rubus*. Although in a footnote (p. 822 in Gray's Manual 8th Ed. 1950) he recognized that hybridization was rife and accounted for many of the morphologically distinctive trends, in only one case *(R. abbrevians)* did he designate a species as a probable hybrid. This is in marked contrast to his treatment of *Salix*, for example, where he described a number of hybrids, and indicated specifically a great many crosses. Fernald established the Section Tholiformes and described many new species in it, several of which were confined to central and northern New Hampshire, others more widely dispersed in

the Northeast and with some local species elsewhere. Fernald also described new species in several of the other Sections. He was somewhat more discriminating than Bailey in the sense that his "species" were more likely to be well defined morphologically. In an earlier paper on hybrids (1963) we indicated that we considered some of Fernald's species to be hybrids of *Rubus hispidus* and *R. setosus*. We were able to locate *R. aculiferus* Fern. which belongs in this category of hybrids at North Woodstock, New Hampshire. On Cape Cod we succeeded in finding *Rubus paludivagus* Fern. which we consider to belong to *R. argutus*. In Fernald's treatment (1950) the New England species fall into eight sections. The Tholiformes seems to be a collection of hybrids and aberrant forms without any common unifying factor. The other sections represent reasonably natural divisions with some overlapping at times but, because in New England several would contain only one or two species, there has seemed little point in our recognizing them. We see no merit in regarding the sections as superspecies, which seems to be an artificial concept of doubtful convenience.

Fernald's major contribution in *Rubus* seems to have been his often sensible evaluation of the work of others such as Blanchard, Brainerd, and Bailey. He seemed to know blackberries in New England better than Bailey did. He was fully aware of the distinctiveness of Blanchard's *R. elegantulus* for example. Fernald screened out a vast array of Bailey's minor "species" though it must be admitted that he might better have omitted many others along with a number of his own making.

Through experience we have found that Fernald's treatment in Gray's Manual with all its prolixity, provides the best starting place for taxonomic work on the group in New England.

The recent handling of our blackberries by Gleason and Cronquist (1963) reflects the commendable decision of the authors to reduce the group to workable size. However the treatment, so far as New England, is concerned, is not satisfactory. The following species are omitted, *Rubus elegan-*

tulus, *R. vermontanus* and *R. semisetosus* while *R. Enslenii* is stated to extend north only to Pennsylvania. Two other species which we do not recognize are given for New England, *Rubus orarius* and *R. ostryifolius*.

Longley (1924) and Einset (1945) have reported chromosome numbers of many species of *Rubus*. Many of Longley's determinations must remain in considerable doubt since there is much question as to the identity of his species and the chromosome numbers are often at variance with the better documented work of Einset whose plants were identified by L. H. Bailey. It seems clear from Einset's findings that *Rubus alleghéniensis* and *R. setosus (R. Boottianus)* have 2N=14 chromosomes, that *R. canadensis* is a triploid with 3N=21 while both *R. flagellaris* and *R. recurvicaulis* have 63 chromosomes. Other species reported by Einset were all polypoids, some of them with variation in chromosome number. Plants of *R. bellobatus* for example, reported to have been collected from two different localities near Ithaca, had chromosome numbers of 21 and 28. Einset reported *Rubus abactus* with 35 chromosomes and *R. avipes* to have 21. Both in our opinion belong in the species *R. pensilvanicus*.

We have been able to identify most mature Rubi that we encounter in the field by means of the present treatment, (providing the primocanes and floricanes are both present) except for young plants that have been excessively stunted by mowing. Many plants encountered would be classified as hybrids in which case it is nearly always possible to specify one or both putative parents. It is hoped in a future article to describe the more common hybrids so that they can be recognized.

It is not possible to identify all herbarium specimens. Early collectors, notably Blanchard and Brainerd, did not include growth-habit notes on the label. Thus a guess as to growth-habit, from the appearance of the plant on the sheet, must be made. At best this is an unsatisfactory procedure and usually is quite impossible. Many collections contain either primocanes or floricanes but not both. Little can be

done with these. The most characteristic part of the primocane in the middle part of the cane with two or three attached leaves. When only the tip is collected, identification is less certain, and in the case of sheets consisting of mere fragments it is impossible.

The characteristics used in the description of *Rubus* require special terms. Growth-habit is the most important single characteristic for major division of species. The primary distinction is between upright and trailing plants. It should be noted, however, that normally erect plants will sometimes become bent over at the edge of a colony and may reach the ground. Species that are normally trailing may arise to a considerable distance off the ground if supported on vegetation. Young primocanes are often erect and do not attain their trailing habit until late in the season. The terms used by us to describe growth habit are *erect, arching, doming, trailing,* and *prostrate. Erect* plants are nearly vertical. *Doming* plants are 1′ to 3′ high and curve so that their tips reach the ground. *Prostrate* plants are in contact with the ground for their full length, whereas *trailing* ones start off as low-domers. The term *reclining* is used for floricanes that are close to the ground, apparently having been lodged by snow.

The nature of the prickles is distinctive. At one extreme are the *stout* broad-based prickles usually 5 mm or more long. At the other extreme are *acicular* prickles with slightly dilated bases, but needle-shaped. *Thin* prickles are intermediate between the two. *Bristles* are no thinner than acicular prickles but are soft to the touch. Prickles if directed backwards are *hooked* if curved, *retrorse* if straight.

In the treatment to follow two introduced species are included in the key but otherwise the study is confined to native Rubi. It must be recognized that cultivars may escape to the wild and persist. At present introduced blackberries do not constitute a major taxonomic problem in New England.

Key to Rubus Subgenus Eubatus in New England

Note, hybrids can not be identified with the key although it may provide a clue to their origin.

Inflorescence mostly a raceme or resembling a cyme or corymb, if paniculate, lacking abundant prickles on pedicels; indigenous species.

Mature primocane doming, trailing or prostrate.
Primocane low-doming, long-trailing or prostrate.
Primocane bristly without strong prickles; leaflets usually 3, coriaceous and lustrous. ..... 6. *R. hispidus*
Primocane with few to many strong and hooked or straight and short prickles, rarely setose; leaflets 3 or 5, not coriaceous.
Cane very slender, 1-2 mm in diameter; inflorescence 1-2-flowered; plant of oak-or oak-hickory-woods. .. 3. *R. Enslenii*
Cane slender to medium, 1.5-4 mm in diameter; well-developed inflorescences 1-12 flowered.
Pedicels erect, up to 6 (averaging 4) cm long; inflorescences 1-3 (5)-flowered.
Leaves glabrous or subglabrous beneath ..... 1. *R. flagellaris*
Leaves pubescent beneath ..... 2. *R. Jaysmithii*
Some pedicels ascending or divergent, central ones short (.5 cm); inflorescences 1-12 flowered.
Leaves glabrous or nearly so beneath ..... 4. *R. recurvicaulis*
Leaves soft-pubescent or velvety beneath ..... 5. *R. arenicola*
Primocanes low-or high-doming, tips often reaching ground.
Canes slender, 1-4 mm in diameter, armed with thin prickles or bristles.
Canes armed with hooked or thin and retrorse sharp prickles ..... 4. *R. recurvicaulis* or 5. *R. arenicola*
Canes armed with bristles or straight acicular prickles 100-200 per decimeter ..... 7. *R. setosus* or prickly forms of 8. *R. vermontanus* 9. *R. semisetosus* and 12. *R. elegantulus*
Canes stout 3-9 mm in diameter, armed with strong straight prickles .. 15. *R. frondosus* or extremes of 13. *R. alleghensis*

Mature primocanes arching or erect.
Well developed plants low, 0.3-1 m high, armed with bristles, acicular prickles or hooked prickles; leaves medium-sized averaging 8-18 cm broad.
Leaves glabrous beneath.
Armature of numerous soft bristles ..... 7. *R. setosus*
Armature of acicular prickles resistant to touch.
Central petiolule 1.4-2 cm long. ..... 8. *R. vermontanus*
Central petiolule 2.5-4 cm long. ..... 12. *R. elegantulus*
Leaves pubescent beneath.
Leaves pilose to velvety beneath, armature of acicular prickles. ..... 9. *R. semisetosus*

Leaves densely tomentose beneath, armature of strong, stout hooked prickles, ... 10. *R. cuneifolius*

Well-developed plants 1-2 m high; leaves large, averaging 12-24 cm broad.

Leaves glabrous beneath.

Armature of 0-10 thin prickles per decimeter. ..... 11. *R. canadensis*

Armature of 10-100 prickles per decimeter. ..... 12. *R. elegantulus*

Leaves pubescent or velvety beneath.

Axis of inflorescence pubescent and with numerous stipitate glands. ..... 13. *R. allegheniensis*

Axis of inflorescence pubescent, glandless or rarely with glands.

Leaflets lanceolate, ratio of width to length 0.5 or less, base rounded to cuneate. ..... 14. *R. argutus*

Leaflets ovate, ratio greater than 0.5, base cordate to rounded.

Leaves chartaceous or subchartaceous; prickles thin to stout, 4-6 mm long, often numerous, 4-60 per dm. ..... 15. *R. frondosus*

Leaves subchartaceous to membranaceous; prickles thin to medium, 2-4 mm long, usually few 0-20 per dm. ..... 16. *R. pensilvanicus*

Inflorescence a large terminal panicle, its branches and pedicels with abundant prickles; introduced species of southern New England.

Leaflets deeply cut, green beneath. ..... *R. laciniatus*

Leaflets merely toothed, white-velutinous beneath. ..... *R. bifrons*

1. *Rubus flagellaris* Willd. PRIMOCANE trailing to prostrate (sometimes climbing over low vegetation), commonly tip-rooting; FLORICANE trailing to prostrate; ARMATURE of hooked prickles 1-3(4) mm long, 5-50 per dm, occasionally more; DIAMETER OF CANES 1.5-3 mm; PRIMOCANE LEAFLETS mostly 3, sometimes partly divided or 5 in number, mostly chartaceous, ovate or rhombic to suborbicular, the ratio of width to length 0.6-0.8, abruptly acuminate to apex, rounded to base, glabrous above, glabrous or very lightly pubescent on veins beneath; DIMENSIONS OF COMPOUND LEAF 6×6-13×13 cm; INFLORESCENCE a *narrow slender raceme* 6-11 cm long with 1-4 (5) flowers on *nearly erect long pedicels*, lowest and longest pedicels 3-4 (5) cm long, the uppermost 1-2 cm; axis of inflorescence and pedicels usually somewhat pubescent and often prickly, not bearing any glands; early flowering; FRUIT globular or subglobular, ripening early, often of good quality; HABITAT, fields, sandy areas, roadsides and ledges; RANGE, central Maine south and west, common at low elevations.

Five species in this treatment: *R. flagellaris*, *R. Jaysmithii*, *R. Enslenii*, *R. recurvicaulis* and *R. arenicola* belong to the section Flagellares of Gray's Manual. Of these five, the first three appear to be closely related, intergrade frequently, and could, with some justification be considered to form one superspecies. When they are stunted because of mowing, or from an unfavorable site, or when they are not fruiting well, they are difficult to separate. However, when well developed with good floricanes, they can usually be readily identified in the field. The basic division is between the flagellaris group and the recurvicaulis group. Further study may indicate that *R. Jaysmithii* and *R. arenicola* would better be considered as varieties of *R. flagellaris* and *R. recurvicaulis* respectively. They are not well represented in herbaria, but are often encountered in the field, where they can usually be recognized. It may be assumed that all of these species hybridize with each other on occasion, but it would be difficult to establish with certainty the nature of the hybrids.

In identifying members of the group, it should be noted that new primocanes start as arching shoots and do not develop trailing tendencies until the middle of the season. In favorable sites, such as new roadside soil where there is no competition, the primocanes are so vigorous that they develop mounding tendencies, thus falling in the category of the section Tholiformes so far as habit is concerned. On bare gravel or ledge, the primocanes may become excessively long trailing. This seems to be a direct response to environment and is of no diagnostic significance. By mid-August it is common to find vigorous primocane colonies in open areas with masses of canes and few or no fruits. These cannot be identified as to species.

All of these species have small sharp prickles, usually hooked, and are unpleasant to touch. They usually can be recognized as belonging to the flagellares group by this character alone. Under favorable conditions they have fruit of good quality, large and sweet. Because of the prostrate habit and numerous prickles, the fruit is not as easily har-

vested as that of the erect species, but it is often of better quality.

As indicated in the key, *Rubus flagellaris* is distinguished from *R. recurvicaulis* primarily by the inflorescence. In addition it can be noted that *R. flagellaris* tends to be lower than *R. recurvicaulis* and trailing or prostrate, while the latter may be high trailing or doming. *Rubus flagellaris* may trail off the ground on vegetation but will not, under these conditions, get as high above the ground as *R. recurvicaulis*. There also may be a difference in leaves with those of *flagellaris* being smaller and duller.

As indicated above, hybridization is undoubtedly frequent within the flagellares group. These are indications that *Rubus flagellaris* hybridizes with several species in other sections but these hybrids are uncommon.

REPRESENTATIVE SPECIMENS: MAINE: SOMERSET CO., Fairfield, *Fernald & Long 13901* (NEBC); ANDROSCOGGIN CO., Auburn, July 21, 1924, *Bean* (NEBC); CUMBERLAND CO., Standish, *Fernald & Long 13908* (NEBC); YORK CO., Arundel, August 3, 1905, *Blanchard* (NEBC, as *R. geophilus* Blanchard); Alfred, *Fernald & Long 13897* (NEBC). NEW HAMPSHIRE: COÖS CO., Whitefield, *Pease 37861* (NEBC); CARROLL CO., Bartlett, *Steele 3496* (STEELE); Tamworth, *Steele, 2780* (STEELE); STRAFFORD CO., Milton, *Hodgdon & Steele 10908* (NHA); Durham, *Hodgdon 5159* (NHA); BELKNAP CO., Alton, *Hodgdon & Steele 12257* (NHA); MERRIMACK CO., Hooksett, *Hodgdon 10912* (NHA); SULLIVAN CO., Charlestown, *Hodgdon & Steele 11365* (NHA); ROCKINGHAM CO., Seabrook, *Hodgdon & Steele 10911* (NHA). VERMONT: WINDSOR CO., Hartland, *Wheeler 26770* (NEBC); RUTLAND CO., north of Rutland, July 1, 1914, *Brainerd 11* (NEBC); WINDSOR CO., Newfane, *Wheeler 27000* (NEBC). MASSACHUSETTS: ESSEX CO., Salisbury, *Steele & Hodgdon 3501* (STEELE); PLYMOUTH CO., Plymouth, *Fernald & Hunnewell 15232* (NEBC); BRISTOL CO., Dartmouth, August 12, 1910, *Hervey* (NEBC); BARNSTABLE CO., Barnstable, *Fernald 18589* (NEBC); NANTUCKET CO., Nantucket Island, *Bicknell 11907* (NEBC); WORCESTER CO., June 26, 1921, *Weatherby* (NEBC); BERKSHIRE CO., Sheffield, May 30, 1919, *Bean & Fernald* (NEBC); CONNECTICUT: TOLLAND CO., Stafford Springs, *Steele & Hodgdon 3893* (STEELE); HARTFORD CO., Southington, *Andrews 5051* (NEBC); NEW LONDON CO., Stonington, *Hodgdon & Steele 14828* (NHA); NEW HAVEN CO., Oxford, Harger *729* (NEBC).

2. *Rubus Jaysmithii* Bailey. Differs from *R. flagellaris* in having leaflets soft-pubescent or velvety beneath to the touch; in similar

habitats and probably of about the same range as *R. flagellaris*, but less common.

This species is closely related to *R. flagellaris*.

REPRESENTATIVE SPECIMENS: NEW HAMPSHIRE: CARROLL CO., Sandwich, *Hodgdon & Steele 14829* (NHA); GRAFTON CO., Plymouth, *Fernald, 11174* (NEBC); Rummey, *Steele 2869* (STEELE); STRAFFORD CO., Rochester, *Hodgdon 10915* (NHA); MERRIMACK CO., Franklin, *Hodgdon 7270* (NHA); ROCKINGHAM CO., Nottingham, *Hodgdon 14830* (NHA); Salem, *Steele 2281* (STEELE). VERMONT: RUTLAND CO., Rutland, September 15, 1912, *Kirk* (NEBC); WINDHAM CO., West Wardsboro, July 25, 1913, *Brainerd 10* (NEBC); Westminister, *Steele 3498* (STEELE). MASSACHUSETTS: ESSEX CO., Danvers, *Steele 768* (STEELE); NORFOLK CO., Walpole, *Hodgdon & Steele 18431* (NHA); BARNSTABLE CO., Harwich, *Fernald 16930* (NEBC); Chatham, *Fernald 16932* (NEBC); DUKES CO., Marthas Vineyard, July 1, 1913, *Bicknell* (NEBC); NANTUCKET CO., Nantucket Island, *Bicknell 11894* (NEBC); FRANKLIN CO., East Charlmont, July 4, 1921, *Churchill* (NEBC). RHODE ISLAND: NEWPORT CO., Block Island, *Jansson 19* (NEBC); PROVIDENCE CO., East Providence, *Wiegand 1009* (NEBC).

3. *Rubus Enslenii* Tratt. PRIMOCANE mostly trailing, sometimes low-arching (0.3 mm); FLORICANE of similar habit; ARMATURE of thin sharp and hooked prickles, 1-2 mm long, 2-60 per dm; DIAMETER of cane 0.5-2 (2.5) mm; PRIMOCANE LEAFLETS mostly 3, sometimes 5 in number, membranaceous to subchartaceous, ovate, the ratio of width to length 0.6-0.7, subacute to acuminate at apex, rounded to subcuneate at base, glabrous above, essentially glabrous beneath (sometimes finely pubescent on veins); DIMENSIONS OF COMPOUND LEAF 7×7-12×12 cm, AVERAGING SMALLER than *R. flagellaris*; INFLORESCENCE a narrow raceme 2-6 (8) cm long, with *1-2 (3) flowers on nearly erect pedicels*, solitary or longest pedicels 2-6 (8) cm long; axis of inflorescence and pedicels mostly pubescent and with or without prickles, lacking glands; early flowering; FRUIT sparse, often of good quality; HABITAT, dryish woods mostly of oak-hickory and on ledges; RANGE, southern Maine mostly near coast, central and southern New Hampshire southward and westward, less common to the north.

Although this blackberry is at times close to reduced forms of *R. flagellaris* it is the most distinctive of the Flagellares and clearly a good species. In addition to morphological differences it has a distinct range and characteristic environment. Its range in New England is somewhat restricted. It reaches its northern limits in central N. H. and southern Maine. The most characteristic habitat of *Rubus Enslenii* is open oak-hickory woods, but it is also found in

mixed woods and small rocky openings. A small trailing prickly blackberry in hickory-woods is certainly this species.

It is one- or two-flowered with thin stems and small dull glabrous leaves, usually three in number. In shady sites the floricanes may not produce any flowers at all. *Rubus flagellaris* is often one- or two-flowered and may have slender canes, but usually inflorescences can be found with more flowers while the leaves average larger and are often 5 foliate.

REPRESENTATIVE SPECIMENS: MAINE: CUMBERLAND CO., Brunswick, June 28, 1913, *Furbish* (NEBC); YORK COUNTY, Biddeford, *Hodgdon & Steele 14832* (NHA); York, *Hodgdon & Steele 14833* (NHA). NEW HAMPSHIRE: CARROLL CO., Tuftonboro, *Hodgdon & Steele 12243* (NHA); STRAFFORD CO., Durham, *Hodgdon 3032* (NEBC); Durham, *Hodgdon & Steele 14834* (NHA); MERRIMACK CO., Boscawen, *Pease 19150* (NEBC); ROCKINGHAM CO., Nottingham, *Hodgdon & Steele 10916* (NHA); Seabrook, *Hodgdon & Steele 10917* (NHA). MASSACHUSETTS: MIDDLESEX CO., Pepperel, *Steele 2777* (STEELE); Concord, June 1, 1960, *Eaton* (NEBC); Lincoln, June 30, 1956, *Eaton* (NEBC); SUFFOLK CO., Arnold Arboretum, *E. J. Palmer 44596* (NEBC); BARNSTABLE CO., Harwich, *Fernald & Long 16934* (NEBC); NANTUCKET CO., Nantucket Island. *Bicknell 12044* (NEBC); WORCESTER CO., Leominster, *Fernald & Bean 14058* (NEBC). RHODE ISLAND: WASHINGTON CO., Charlestown, *Fernald & Phelps 16936* (NEBC). CONNECTICUT: WINDHAM CO., Putnam, June 11, 1922, *Bill & Grigg* (NEBC); NEW LONDON CO., Franklin, May 25, 1906, *Woodward* (NEBC); Stonington, *Steele & Hodgdon 3890* (STEELE).

4. *Rubus recurvicaulis* Blanch. PRIMOCANE trailing to low doming or low arching to 0.3-0.6 m high, in dense vegetation often appearing suberect early in growth; FLORICANE trailing or reclining to low arching; ARMATURE of stiff hooked or straight retrorse prickles 2-4 mm long, (2-) 10-50 (-100) in number per dm; DIAMETER OF PRIMOCANE 2-4 mm; PRIMOCANE LEAFLETS 3-5 in number, chartaceous, ovate (rhombic), ratio of width to length 0.6-0.8, acuminate at apex, rounded to subcordate at base, glabrous above and glabrous beneath or with slight pubescence on veins beneath; DIMENSIONS OF COMPOUND LEAF 8×8-14×14 cm; INFLORESCENCE a compact to diffuse raceme (corymb of many authors) with *2-8 (1-12) flowers*, 3-9 (2-10) cm long, 2-5 (1-6.5) cm wide, *pedicels spreading to ascending, the longest 1.5-4, the upper 0.5-1 cm long; axis of inflorescence and pedicels* mostly with slight to medium pubescence, prickles often present, glands *absent;* early flowering; FRUIT, poor quality to good; HABITAT, pastures, fields, railroad banks and roadsides; range throughout New England, at low elevations.

This species occupies the same habitats as *Rubus flagellaris* and often resembles it. When properly developed, the inflorescences are distinctive with some flowers on short pedicels, some of which are ascending or diverging as opposed to the erect pedicels of *R. flagellaris*. At times, especially in poor soils, the primocanes do not assume the trailing habit but remain low-arching, not close to the ground. At other times, when there is little competition, the primocanes may form large tangled doming and trailing colonies with few well-developed inflorescences. The colonies may be difficult to classify, but growth-habit alone will suggest an affinity to *R. recurvicaulis* rather than *R. flagellaris*.

The fresh leaves of this species vary from dull to lustrous and the margins may be plicate when the leaves are young. This tendency has led to the "Manual" species *R. plicatifolius* not here recognized.

Most blackberries grow in disturbed locations and thus the stations tend to be temporary. An apparently natural location for the flagellares-group is pockets of soil on ledges and cliffs. Most New England cliffs will contain one of these species presumably growing in natural and virgin sites, as such habitats have been little disturbed by agriculture and lumbering.

REPRESENTATIVE SPECIMENS: MAINE: AROOSTOOK CO., Fort Kent, July 6, 1906, *Fernald* (GH); Ashland, August 8, 1901, *Fernald* (NEBC); PENOBSCOT CO., Oldtown, *Fernald & Long 13883* (NEBC); PISCATAQUIS CO., Abbot, *Fernald & Long 13875* (NEBC); OXFORD CO., Rumford, *Fernald & Pease 2516* (NEBC); WASHINGTON CO., Roque Bluff, July 25, 1913, *Knowlton* (NEBC); KNOX CO., Matinicus, July 19, 1920, *C. A. E. Long* (NEBC); LINCOLN CO., Monhegan Island, *Hodgdon & Hodgdon 12941* (NHA); Southport Island, *Hodgdon 7228* (NHA); KENNEBEC CO., Vassalboro, *Fernald 13904* (NEBC); CUMBERLAND CO., Harpswell, *Hodgdon & Steele 12169* (NHA); YORK CO., Alfred, *Fernald & Long 13898* (NEBC); Kittery, *Hodgdon & Steele 12171* (NHA). NEW HAMPSHIRE: COÖS CO., Shelburne, *Pease 11162* (NEBC); CARROLL CO., North Conway, *Hodgdon & Steele 12189* (NHA); Sandwich, *Hodgdon & Steele 14835* (NHA); GRAFTON CO., Lincoln, *Fernald 15796* (NEBC); Campton, *Hodgdon & Steele 11354* (NHA); STRAFFORD CO., Durham, *Hodgdon 12261* (NHA); Milton, *Hodgdon & Steele 10920* (NHA); ROCKINGHAM CO., Northwood, *Hodgdon & Steele 10930* (NHA); Seabrook, *Hodgdon & Steele 10928* (NHA); HILLSBORO CO., Litchfield, *Steele & Hodgdon 3842* (STEELE).

VERMONT: WINDHAM CO., Westminster, *Steele 3479* (STEELE); BENNINGTON CO., Searsburg,, June 20, 1925, *Carpenter, Churchill & Knowlton* (NEBC). MASSACHUSETTS: MIDDLESEX CO., Concord, June 19, 1958, *Eaton* (NEBC); BARNSTABLE CO., Barnstable, *Woodward & Fernald 1523* (NEBC); WORCESTER CO., Royalston, *Steele & Hodgdon 3819* (STEELE); HAMPSHIRE CO., Middlefield, *Fernald & Long 9678* (NEBC); HAMPTON CO., Springfield, June 17, 1914, *Andrews* (NEBC). Specimens from Rhode Island and Connecticut in the herbarium of the New England Botanical Club are hardly adequate for purposes of citation.

5. *Rubus arenicola* Blanch. Differs from *R. recurvicaulis* chiefly in having *leaves abundantly pilose to soft-velvety beneath* and *axis of inflorescence and pedicels with medium to strong pubescence;* HABITAT, dry fields, roadsides, alluvial plains, and ledges; RANGE, southern and western Maine, northern New Hampshire and southward at low elevations.

This blackberry is closely related to *R. recurvicaulis,* but at times seems markedly distinct. In its best marked states it occurs in large doming and trailing colonies on sandy soil, with fruit of superior quality.

REPRESENTATIVE SPECIMENS: MAINE: YORK CO., Kennebunkport, July 6, 1905, *Blanchard* (NEBC). NEW HAMPSHIRE: COÖS CO., Shelburne, August 9, 1921, *Deane* (NEBC); CARROLL CO., Tamworth, *Hodgdon & Steele 7782* (NHA); Ossipee, July 14, 1951, *Steele* (NHA); Sandwich, *Steele & Hodgdon 764* (STEELE); GRAFTON CO., Holderness, *Hodgdon, Steele & Lincoln 11317* (NHA); Plymouth, *Hodgdon & Steele 10918* (NHA); STRAFFORD CO., Milton, *Steele & Hodgdon 2932* (STEELE); Durham, *Hodgdon, Pike & Schreiber 7260* (NHA); ROCKINGHAM CO., Deerfield, *Steele & Hodgdon 3769* (STEELE); Seabrook, *Hodgdon & Steele 10919* (NHA); HILLSBORO CO., Pelham, *Hodgdon & Eldredge 7256* (NHA). MASSACHUSETTS: ESSEX CO., Newburyport, *Steele 3834* (STEELE); PLYMOUTH CO., Marshfield, July 4, 1914, *Knowlton* (NEBC); BARNSTABLE CO., Chatham, *Fernald & Long 18593* (NEBC); Harwich, *Steele & Hodgdon 3924* (STEELE); Sandwich, *Steele & Hodgdon 3895* (STEELE); DUKES CO., West Tisbury, *Fernald & Fogg 920* (NEBC); NANTUCKET CO., Nantucket Island, *Bicknell 11952* (NEBC); WORCESTER CO., Sterling, *Steele & Hodgdon 3897* (STEELE). RHODE ISLAND: NEWPORT CO., Portsmouth, July 28, 1924, *Sanford* (NEBC, Cotype of *R. rhodinsulans* Bailey).

6. *Rubus hispidus* L. PRIMOCANE prostrate and often tip-rooting in late summer or sometimes trailing over vegetation; FLORICANE prostrate or trailing; ARMATURE of thin hooked prickles resistant to touch or of soft green to purple bristles 2-3 mm long, 0-2000 per dm; DIAMETER OF CANES 1-2(3) mm; PRIMOCANE LEAFLETS 3 in number, occasionally 5, *lustrous, coriaceous* (sometimes dull), tending

to be evergreen, ratio of width to length 0.65 or more, obovate (broadest above the middle), *apex obtuse*, *abruptly pointed* or *acute* (never acuminate), the base rounded or subcuneate, 3.5-5(7) cm long, glabrous above and beneath, teeth somewhat rounded or abruptly pointed; DIMENSIONS OF COMPOUND LEAF 6×6-9×9 cm; INFLORESCENCE a compact raceme 2-4.5 cm long with 4-10 flowers on ascending to divergent pedicels, the axis pilose, setae often present, glands lacking or few and of uniform length; *late flowering*, FRUIT usually not developing or, if maturing, small and sour; HABITAT, fields, open woods especially pine, gravel pits, peaty soil and peat bogs; RANGE, common throughout New England at low elevations.

This is one of the oldest and best-marked species. Except when reclining on vegetation, it is low-trailing or prostrate and tip-rooting, the lowest of the blackberries. The armature is of bristles or weak prickles not painful to touch. The leaves are small, obovate, coriaceous and usually shiny. These features serve to easily identify this blackberry in most cases. Like some of the others, it grows in a variety of situations, but is the only one to invade acid peat bogs.

It flowers later than most species and the fruit, if it develops at all, is sour and of inferior quality.

The authors have investigated in detail its hybridization with *R. setosus* (Rhodora 65: 262-270). These hybrids are frequent and several have been designated as species. The hybrids frequently backcross with one of the parents, and the introgression of *R. setosus* into the plant gives rise to forms of *R. hispidus* which are not typical and may suggest new species. There is fairly good evidence of hybridization with *R. alleghaniensis* and *vermontanus* but the details need to be worked out.

A large-leafed form of *Rubus hispidus* occurs with leaves twice as large as the typical but similar in other respects. Although at times this may appear to be distinctive, there is insufficient evidence to consider it a separate species.

REPRESENTATIVE SPECIMENS: MAINE: PENOBSCOT CO., Orono, July 9, 1888, *Fernald* (NEBC); SOMERSET CO., Lexington Plantation, *Pease 34502* (NEBC); WASHINGTON CO., Machias, August 13, 1942, (NEBC); Hancock Co., Mt. Desert, July 14, 1897, *Williams* (NEBC); WALDO CO., Burnham, July 24, 1940, *Bean* (NEBC); KNOX CO., Friendship, *Pease 747* (NEBC); LINCOLN CO., Southport, August 1, 1894, *Fernald* (NBEC); Boothbay Harbor, *Hodgdon 12254* (NHA);

SAGADAHOC CO., Georgetown (Five Islands), *Rehder 1045* (GH); ANDROSCOGGIN CO., East Livermore, *Furbish* (NEBC); YORK CO., Alfred, *Fernald & Long 13893* (NEBC). NEW HAMPSHIRE: COÖS CO., Colebrook, *Pease 29760* (NEBC); Jefferson, *Pease 33126* (NEBC); CARROLL CO., Madison, June 28, 1951, *Steele* (NEBC); Tamworth, *Steele 2859* (STEELE); GRAFTON CO., Waterville, *Steele 2921* (STEELE); STRAFFORD CO., Milton, *Hodgdon & Steele 11202* (NHA); Durham, *Hodgdon 12168* (NHA); BELKNAP CO., Alton, *Hodgdon & Steele 12191* (NHA); MERRIMACK CO., Bradford, *Hodgdon, Steele, Lincoln & Harrington 7443* (NHA); SULLIVAN CO., Charlestown, *Hodgdon & Steele 11363* (NHA); ROCKINGHAM CO., Northwood, *Hodgdon & Steele 11195* (NHA); HILLSBORO CO., Peterboro, October 3, 1907, *Batchelder* (NEBC); CHESHIRE CO., Rindge, August 19, 1916, BATCHELDER (NEBC). VERMONT: ORLEANS CO., East Charleston, *Pease 34755* (NEBC); CHITTENDEN CO., June 27, 1931, *Kittredge* (NEBC); WINDSOR CO., North Woodstock, July 15, 1914, *Forbes* (NEBC); RUTLAND CO., Castleton, August 20, 1940, *Knowlton* (NEBC); WINDSOR CO., Stratton, July 15, 1912, *Wheeler* (NEBC). MASSACHUSETTS: ESSEX CO., Rockport, *Forbes 1902* (NEBC); MIDDLESEX CO., Billerica, August 20, *Manning* (NEBC); BRISTOL CO., Westport, September 10, 1916, *Sanford* (NEBC); NANTUCKET CO., Nantucket, June 24, 1910, *Bicknell* (NEBC); WORCESTER CO., Holden, July 7, 1946, *Gates & Gates* (NEBC); FRANKLIN CO., Rowe, May 15, 1915, *Harger & Schweinfurth* (NEBC); BERKSHIRE CO., Sandisfield, July 19, 1912, *Hoffman* (NEBC). RHODE ISLAND: PROVIDENCE CO., Providence, June 1878, *W. W. Bailey* (NEBC); WASHINGTON CO., South Kingston, June 10, 1927, *Bill, Eaton & Gilbert* (NEBC); NEWPORT CO., Block Island, August 13, 1919, *Graves* (NEBC). CONNECTICUT: WINDHAM CO., Thompson, July 6, 1921, *Weatherby* (NEBC); HARTFORD CO., East Hartford, *Clark & Weatherby 130* (NEBC); NEW LONDON CO., Stonington, *Hodgdon & Steele 14837* (NHA); NEW HAVEN CO., Oxford, August 4, 1901, *Harger* (NEBC).

7. *Rubus setosus* Bigel. PRIMOCANE arching to erect (sometimes doming) of medium height; FLORICANE reclining or trailing on ground; ARMATURE of *abundant soft bristles and glands* (600) 2000-5000 per dm; CANE DIAMETER 2-5 mm; PRIMOCANE LEAFLETS 5, *chartaceous with impressed veins*, elliptic to obovate, usually broadest at middle, ratio of width to length 0.5 — 0.7, acute or acuminate, 6-11 cm. long, glabrous above and beneath, teeth acute, leaf-base rounded to cuneate; dimensions OF COMPOUND LEAF 6×6-14×14; INFLORESCENCE a compact to diffuse raceme 7-11 cm long; late-flowering, number of flowers 5-11; floral axis pubescent, bristles often present, glands frequent to abundant on stalks of uneven lengths; FRUIT failing to develop or of poor quality, small; HABITAT, alluvial plains, poorly drained soil, grassy swamps, open land; RANGE, common in northern New England, becoming less frequent southward to central Connecticut, at low elevations.

This is a long-recognized and distinctive species best developed in poorly drained soil and alluvial meadows. It oftens grows in swales or bushy swamps but hardly ever in peat bogs. It is essentially an erect plant of medium height with rather slender canes. The abundant soft bristles are characteristic. These are not unpleasant to touch as compared with the sharp thin prickles of *R. vermontanus*. In deep vegetation the plant grows tall, the bristles may be much less numerous, and the floricanes poorly developed and difficult to locate. The fruit usually does not develop and when it does it is small and of inferior quality.

REPRESENTATIVE SPECIMENS: MAINE: PENOBSCOT CO., Winn, *Fernald & Long 13889* (NEBC); PISCATAQUIS CO., Brownville, *Parlin 1886* (GH); FRANKLIN CO., Farmington, July 24, 1915, *Knowlton* (NEBC); OXFORD CO., Bethel, August 7, 1929, *Wheeler* (NEBC); WASHINGTON CO., Princeton, July 22, 1909, *Fernald* (GH); HANCOCK CO., Mt. Desert, July 2, 1896, *Rand* (NEBC); ANDROSCOGGIN CO., South Poland, 1895, *Furbish* (NEBC); CUMBERLAND CO., Baldwin, *Fernald & Long 13885* (NEBC); YORK CO., South Berwick, September 26, 1897, *Parlin* (NEBC). NEW HAMPSHIRE: COÖS CO., Berlin, *Pease 17060* (NEBC); CARROLL CO., Ossipee, August 4, 1943, *Knowlton* (NEBC); North Conway, *Hodgdon & Steele 11204* (NHA); GRAFTON CO., Easton, *Fernald 15826* (NEBC); Plymouth, *Hodgdon & Steele 11173* (NHA); STRAFFORD CO., Rochester, *Hodgdon 3461* (NEBC); BELKNAP CO., Laconia, *Fernald 15776* (NEBC); SULLIVAN CO., Langdon, August 23, 1963, *Richardson & Seymour* (NEBC); ROCKINGHAM CO., Nottingham, *Hodgdon 10199* (NEBC); HILLSBORO CO., Peterboro, July 10, 1888, *Deane* (NEBC). VERMONT: ESSEX CO., Brighton, *Pease 33683* (NEBC); FRANKLIN CO., Berkshire, July 1916, *Knowlton* (NEBC); ADDISON CO., Ripton, July 19, 1900, *Brainerd & Eggleston* (NEBC); RUTLAND CO., Wallingford, *Brainerd 1225* (NEBC); WINDHAM CO., Stratton, *Underwood 3038* (NEBC). MASSACHUSETTS: MIDDLESEX CO., Lexington, August 19, 1908, *Kennedy* (NEBC); WORCESTER CO., Ashland, *Gates 31415* (NEBC); Sterling, *Steele & Hodgdon 3947* (NHA, STEELE). CONNECTICUT: WINDHAM CO., Hampton, *Hunnewell 12620* (NEBC); NEW LONDON CO., Franklin, June 26, 1905, *Graves* (GH); TOLLAND CO., Bolton, *Weatherby 3166* (NEBC); Strafford, August 29, 1903, *Graves* (GH); HARTFORD CO., Southington, *Andrews 5014* (NEBC); LITCHFIELD CO., Colebrook, *Weatherby 2668* (NEBC); FAIRFIELD CO., Botsford, June 27, 1897, *Eames* (NEBC).

8. *Rubus vermontanus* Blanch. PRIMOCANE erect or arching, of medium height (0.3-0.9), less often doming or high trailing; FLORICANE arching or reclining; ARMATURE usually of *acicular straightish prickles 2-4 mm long, stiff and unpleasant to touch*, less often hooked

50-500 (10-250) per dm; DIAMETER OF CANE 2-4 mm; PRIMOCANE LEAFLETS 5, chartaceous or subchartaceous, veins impressed, rhombic, elliptic or obovate, broadest at middle or above middle, ratio of width to length 0.5-0.7, apex acute or abruptly acuminate, 6-12 cm long, glabrous on upper and lower surfaces usually with slight pubescence on main veins evident under magnification, teeth acute, base rounded to cuneate, *central petiolules 1.4-2.0 (0.8-0.3) cm long, longest lateral petiolules 0-1 (1.7) cm long;* DIMENSIONS OF COMPOUND LEAF 9×9-18×18 cm; INFLORESCENCE similar to *R. setosus* but thin prickles usually present as well as glands; early flowering; FRUIT small, often underdeveloped, of poor to fair quality; HABITAT, lumbered areas, sterile fields, thickets and bases of cliffs; RANGE, northern New England common, becoming less abundant southward to Connecticut, medium and low elevations.

This is a distinctive species in northern New England, common in open lumbered areas and run out fields. It most closely resembles *R. elegantulus* and at times is difficult to distinguish from that species, perhaps because of hybridization. The following characters serve to separate it; height averaging low, 1-3′ (*R. elegantulus*, 2-4′) ; length of petiolules, central usually less than 2 cm, (*R. elegantulus* more than 1 cm) ; floral axis frequently with glands, (*R. elegantulus* never with glands). In growth-habit and appearance this plant resembles *R. setosus*, but the armature is distinctively different. Although the leaves apparently are glabrous, some hairs can usually be seen under magnification on the main veins beneath. However these two species frequently hybridize forming various intermediate states, many of which have been designated as *R. Groutianus. Rubus vermontanus* also occurs in doming, excessively prickly forms which have been designated as *R. severus.* This possibly represents introgression with some of the flagellares. *Rubus vermontanus* appears to hybridize with several other species producing puzzling mongrel populations. In southern New England it tends to be replaced by *R. semisetosus* and to hybridize with it.

At high elevations above 300 feet in boggy places a blackberry occurs which we have assigned to *R. elegantulus* but it has some of the characteristics of *R. vermontanus.* It does not seem to be a hybrid of them, however, as neither of the putative parents is present.

REPRESENTATIVE SPECIMENS: MAINE: AROOSTOOK CO., Fort Fairfield, August 10, 1909, *Fernald & Wiegand* (GH); PENOBSCOT CO., Stacyville, July 3, 1900, *Churchill* (NEBC); PISCATAQUIS CO., Dover, September 2, 1896, *Fernald* (NEBC); FRANKLIN CO., Chain of Ponds, *Pease & Bean 33605* (NEBC); OXFORD CO., Canton, *Parlin 2002* (NEBC); Mason, *Hodgdon & Steele 11313* (NHA); WASHINGTON CO., Cutler, July 30, 1902, *Furbish* (NEBC); Pembroke, August 18, 1909, *Fernald & Wiegand* (GH); HANCOCK CO., Mt. Desert, July 1, 1896, *Rand* (NEBC); KNOX CO., Thomaston, *Bissell, Fernald & Chamberlain 7697* (NEBC); LINCOLN CO., Boothbay (Ocean Point), *Hodgdon 12269* (NHA); YORK CO., Kennebunk, July 3, 1905, *Blanchard* (NEBC); Biddeford, *Hodgdon & Steele 12255* (NHA). NEW HAMPSHIRE: COÖS CO., Shelburne, *Fernald & Pease 15746* (NEBC); CARROLL CO., North Conway, *Hodgdon & Steele 11208* (NHA); Conway, *Pease 28776* (NEBC); GRAFTON CO., Woodstock, *Fernald 11743* (NEBC); Plymouth, *Hodgdon & Steele 11211* (NHA); STRAFFORD CO., New Durham, *Steele & Hodgdon 3703* (STEELE); Rollinsford, *Hodgdon 11367* (NHA); BELKNAP CO., Laconia, *Fernald 15777* (NEBC, as var. *viridiflorus*); Alton, *Hodgdon & Steele 12195* (NHA); SULLIVAN CO., Grantham, *Hodgdon, Steele, Page & Stearns 7781* (NHA); ROCKINGHAM CO., Seabrook, *Hodgdon & Steele 1180* (NHA); HILLSBORO CO., Nashua, *Hodgdon & Steele 11299* (NHA). VERMONT: ESSEX CO., Ferdinand, *Pease 25694* (NEBC); ORLEANS CO., Westmore, *Floyd 2264* (NEBC); ADDISON CO., Ripton, July 27, 1914, *Brainerd* (NEBC); RUTLAND CO., East Wallingford, June 27, 1909, *Kent* (NEBC); WINDHAM CO., West Dover, August 13, 1928, *Eaton* (NEBC); Windham, June 20, 1904, *Blanchard* (GH type; BENNINGTON CO., Woodford, June 29, 1939, *Knowlton* (NEBC). MASSACHUSETTS: ESSEX CO. Plum Island, *Steele & Hodgdon 3833* (STEELE); BERKSHIRE CO., Becket, July 9, 1920, *Hoffmann* (NEBC). RHODE ISLAND: PROVIDENCE CO., Diamond Hill, *E. J. Palmer 45604* (GH as *R. significans* Bailey). CONNECTICUT: WINDHAM CO., Thompson, *Weatherby 5051* (NEBC); HARTFORD CO., Berlin, *Hodgdon & Steele 14838* (NHA); East Hartford, *Ashe & Weatherby 5356* (NEBC).

9. *Rubus semisetosus* Blanch. PRIMOCANE erect or arching, of medium height (0.3-0.9 m); FLORICANE erect or reclining; ARMATURE of *acicular to thin prickles 2-4 mm long*, 25-100 per dm; DIAMETER OF CANE 25 mm; PRIMOCANE LEAFLETS 5 (occasionally 3), membranaceous or chartaceous, ovate or rhombic, 6-9 cm long, ratio of width to length averages 0.6-0.7, glabrous or occasionally minutely pilose above, *strongly pilose to velvety beneath*, base of leaflet round to cuneate rarely cordate, central petiolule 1-1.8 cm long, longest lateral petiolules 0.2-0.7 mm long; DIMENSIONS OF COMPOUND LEAF 8×8-14×14 (17×17) cm; INFLORESCENCE similar to *R. vermontanus*, floral axis always pubescent, thin prickles often present, glands rarely present; FRUIT undeveloped or poor; HABITAT, swales, thickets

and open fields; RANGE, coast of Maine, southern New Hampshire occasional, moderately common from Massachusetts southward.

This blackberry is most closely related to *Rubus vermontanus* and replaces it in southern New England. The two differ in pubescence of leaves; *R. vermontanus* has leaves glabrous on the underneath side with a minute pubescence on the veins whereas *R. semisetosus* has leaves soft-velvety to the touch. In southern New Hampshire some plants with only a slight pubescence are found along with good *R. semisetosus*. Farther south *R. vermontanus* is rare with *R. semisetosus* replacing it. Thus there appear to be two distinct species that have a transition zone of intergradation.

Rubus semisetosus is also close to the Arguti, especially to *R. argutus*. It is a smaller plant, however, and the leaf-shape is usually distinctive. *Rubus semisetosus* typically has rather broad obovate or rhombic leaves, whereas *R. argutus* has narrow lanceolate leaves. It definitely hybridizes with *R. setosus* and *R. vermontanus* and probably with other species.

REPRESENTATIVE SPECIMENS: MAINE: HANCOCK CO., Mt. Desert Island, July 8, 1894, *Rand* (NEBC); Mt. Desert Island, September 7, 1896, *Rand* (NEBC). NEW HAMPSHIRE: ROCKINGHAM CO., Nottingham, *Hodgdon 14839* (NHA); HILLSBORO CO., Merrimack. *Steele & Hodgdon 3830* (STEELE). MASSACHUSETTS: MIDDLESEX CO., Pepperel, *Hodgdon & Steele 14880* (NHA); Concord, June 16, 1962, *Eaton 5205* (NEBC); Concord, July 16, 1961, *Eaton* (NHA); NORFOLK CO., Millis, *Hodgdon & Steele 14841* (NHA); Walpole, *Hodgdon & Steele 14842* (NHA); Medway, *Hodgdon & Steele 14843* (NHA); PLYMOUTH CO., Carver, *Fernald, Hunnewell & Long 9667* (NEBC); BARNSTABLE CO., Brewster, *Steele & Hodgdon 3878* (STEELE); WORCESTER CO., Sterling, *Hodgdon & Steele 14844* (NHA); HAMPDEN CO., Springfield, *Weatherby 5918* (NEBC). RHODE ISLAND: WASHINGTON CO., Kingston, July 30, 1906, *Blanchard* (GH type); Kingston, *Steele & Hodgdon 3877* (STEELE); Kenyon, *Fernald & Weatherby 843* (GH, NHA). CONNECTICUT: HARTFORD CO., East Hartford, *Weatherby 4905* (NEBC); New Canaan, *Steele 3948* (STEELE); NEW HAVEN CO., North Branford, August 17, 1940, *Harger* (NEBC); FAIRFIELD CO., Greenwich, June 20, 1913, *Bissell & Weatherby* (NEBC).

10. *Rubus cuneifolius* Pursh PRIMOCANES stiff-erect to arching or occasionally trailing, of medium height (0.3-0.9 m); FLORICANES similar, often branched; ARMATURE of numerous (20-50 per dm) thin

to stout *stiff straight or hooked prickles;* PRIMOCANES *usually* PUBESCENT, DIAMETER OF CANE 2-4 mm; PRIMOCANE LEAFLETS 3 or 5, chartaceous or subcoriaceous, glabrous above, closely *white-or gray-tomentose beneath, obovate, base cuneate,* broadest above the middle, ratio of width to length averaging 0.6-0.7, apex rounded or abruptly pointed, length 2-5 cm; DIMENSIONS OF COMPOUND LEAF average 6×6-8×8 cm, INFLORESCENCE prickly-pubescent, of few-flowered small racemes or cymes; early flowering; FRUIT dry and seedy or sweet and of good quality; HABITAT, sandy or rocky and open dry lands; RANGE, southern Connecticut, where uncommon and isolated in Hillsboro, N. H.

This is a very distinctive southern species of the Coastal Plain and Lower Piedmont which enters New England only in southern Connecticut except for a highly disjunct station in Hillsboro County, New Hampshire.

REPRESENTATIVE SPECIMENS: NEW HAMPSHIRE: HILLSBORO CO., Hillsboro, October 22, 1966, *William Cottrell* (NEBC, NHA). CONNECTICUT: HARTFORD CO., Southington, June 13, 1900, *Bissell* (NEBC); MIDDLESEX CO., Portland, June 24, 1897, *Starmer* (NEBC); NEW HAVEN CO., North Branford, June 18, 1927, *Harger* (NEBC); LITCHFIELD CO., Woodbury, August 12, 1926, *Harger* (NEBC); FAIRFIELD CO., Bridgeport, July 4, 1890, *Johnson* (NEBC).

11. *Rubus canadensis* L. PRIMOCANE and FLORICANE 1-2 (2.5) m high, erect to somewhat arching; *armature* of *acicular to weak prickles or none,* 0.5-3 mm long, 0-7 (9) per dm; DIAMETER OF PRIMOCANE 2-7 mm; PRIMOCANE LEAFLETS 5, membranaceous, ovate, ratio of width to length 0.5-0.7, acuminate or occasionally abruptly pointed, 7-14 cm long, *glabrous on both surfaces,* cordate to rounded at base, *central petiolules 1.5-5 cm long, longest lateral petiolules 0.5-2 cm;* dimensions of compound leaf 10×10-24×24 cm; INFLORESCENCE varying from long racemes (11 cm long by 5 cm) to short racemes (7 cm long by 6 cm) to extremes of small diffuse racemes with thin pedicels, the flowers 6-14 in number; axis of inflorescence and pedicels pubescent to subglabrous, *lacking glands and prickles;* flowering in midseason; FRUIT sour, often poorly developed, occasionally of fair quality; HABITAT, moist thickets, openings in northern hardwood forest, bases of cliffs, occasionally ascending mountains to 1100 m; RANGE, northern New England south to mountainous areas of Massachusetts and Connecticut, common in north, less common southward.

This species, along with *R. elegantulus,* and *R. vermontanus* appear to be the three northernmost blackberries, all occurring in Newfoundland. In New England *R. canadensis* is characteristic of mountainous areas and ascends higher than any other blackberry. It is often found in open

hardwoods or near ledges at 2000 feet and has been collected on Mt. Washington at 3600 feet which is the highest recorded altitude for any blackberry in New England. It occurs in a variety of lowland habitats but its most characteristic environment seems to be open hardwoods and moist thickets.

It is usually a distinctive well-marked plant, a high blackberry with glabrous leaves and a stem nearly devoid of prickles, the few present being small and weak. Close examination of the leaves under magnification indicates that they are either completely glabrous or have a few hairs on the main nerves. Any pubescence that could be detected without a lens would indicate there was introgression with some other species, presumably *R. pensilvanicus*.

REPRESENTATIVE SPECIMENS: MAINE: AROOSTOOK CO., Van Buren, July 17, 1914, *Knowlton* (NEBC); PENOBSCOT CO., Bangor, June 27, 1909, *Blanchard* (GH); PISCATAQUIS CO., Abbot, *Fernald & Long 13879* (NEBC); FRANKLIN CO., Industry July 9, 1896, *Fernald* (NEBC); OXFORD CO., Greenwood, June 13, 1931, *Bill, Eaton, Fernald, Griscom & Hunnewell* (NEBC); WASHINGTON CO., Pembroke, July 7, 1909, *Fernald & Wiegand* (GH); HANCOCK CO., Dedham, *Fernald & Long 13877* (NEBC); WALDO CO., Islesboro, *Woodward, Bissell & Fernald 9672* (NEBC); LINCOLN CO., Monhegan Island, *Hodgdon & Hodgdon 12808* (NHA); ANDROSCOGGIN CO., South Poland, 1893, *Furbish* (NEBC); YORK CO., Kittery, *Fernald & Long 13880* (NEBC). NEW HAMPSHIRE: COÖS CO., Dartmouth College Grant, *Pease & Harris, 33915* (NEBC); Dummer, *Hodgdon & Steele 11269* (NHA, STEELE); CARROLL CO., Sandwich, *Steele 3547* (STEELE); GRAFTON CO., Thornton, *Hodgdon & Steele 12373* (NHA); Franconia, August 7, 1919, *Deane* (NEBC); STRAFFORD CO., Barrington, *Hodgdon & Steele 7279* (NHA); BELKNAP CO., Gilford, *Fernald 15654* (NEBC); HILLSBORO CO., Peterboro, *Ware 4127* (NEBC); Hollis, *Steele & Hodgdon 4008* (STEELE); CHESHIRE CO., Gilsum, *Fernald 321* (NEBC); Alstead, June 14, 1903 — August 16, 1903, *Blanchard* (GH all marked type). VERMONT: ORLEANS CO., Lowell, August 9, 1915, *Winslow* (NEBC); ADDISON CO., Ripton, July 5, 1914, *Brainerd* (NEBC); WINDSOR CO., North Woodstock, July 15, 1914, *Forbes* (NEBC); RUTLAND CO., Pittsfield, July 27, 1933, *Knowlton* (NEBC); WINDHAM CO., Marlboro, June 28, 1939, *Knowlton* (NEBC). MASSACHUSETTS: WORCESTER CO., Princeton, July 22, 1913, *Weatherby* (NEBC); FRANKLIN CO., Ashfield, June 19, 1921, *Churchill, Hunnewell, Knowlton & Svenson* (NEBC); BERKSHIRE CO., New Marlboro, July 12, 1912, *R. Hoffmann* (NEBC). CONNECTICUT: TOLLAND CO., Union, August 31, 1903, *Graves* (GH); HARTFORD CO., Hartland,

Weatherby 3093 (NEBC); LITCHFIELD CO., Colebrook, September 5, 1909, *Fernald* (GH); FAIRFIELD CO., Danbury, *Blewitt 2047* (NEBC).

12. *Rubus elegantulus* Blanch. PRIMOCANE and FLORICANE arching or less often doming 0.3-1 m high; *armature* of *thin to acicular prickles* 1-4 mm long, 10-60 (100) per dm; DIAMETER OF CANE 3-6 mm; PRIMOCANE LEAFLETS 5, membranaceous (occasionally chartaceous), lanceolate, ovate or elliptic, 7-14 cm long, apex acuminate or sometimes abrupt-acuminate, base of central leaflet cordate, lateral leaflet rounded, *glabrous above and below; petiolules of central leaflet 2.5-4 (1.5-5) cm long, longest lateral petiolules 1-2 (0.3-2.5) cm long;* DIMENSIONS OF COMPOUND LEAF 11×11-22×22 cm; INFLORESCENCE in shape similar to *R. vermontanus*, 6-17 cm long; floral axis pubescent often with small prickles but no glands; flowering in midseason, the number of flowers 3-15 (21); FRUIT undeveloped or small (rarely large and of good quality); HABITAT, old fields, moist or dry thickets, woods, bases of ledges, ascending to 1000 m in moist peaty soil; RANGE, northern New England where common, becoming less abundant southward in New Hampshire and Vermont and occasional in areas of high elevation in Massachusetts.

Although this species was not recognized by Bailey, it seems to be a distinct and wide-ranging blackberry of northern New England. It would be difficult to understand the blackberry-flora without recognizing this as a species. It has been considered as a variety of *R. canadensis*, from which it is separated principally by the number of prickles on the primocane, and there are occasional states of *R. canadensis* that are difficult to assign to either species. In most cases, however, *R. elegantulus* is closer to *R. vermontanus*, and can be distinguished only by careful examination as noted in the description of the latter species. Some of the mountain-forms are difficult to assign to either species and possibly are stable hybrid colonies of considerable age. Thus *R. elegantulus* represents a transition between *R. vermontanus* and *R. canadensis*, but has a range of sufficient extent and is constant enough to be maintained as a species in its own right. It appears to cross more frequently with *R. setosus* than any other. Shorter hybrids are impossible to distinguish from hybrids of *R. setosus* and *R. vermontanus*, except by taking note of the occurrence of the putative parents in the area.

The leaves are typically glabrous beneath as in *R. cana-*

densis. Good *R. elegantulus* may have very light pubescence on the main veins not noticeable without a lens. More obvious pubescence indicates introgression with *R. pensilvanicus*.

REPRESENTATIVE SPECIMENS: MAINE: OXFORD CO., Mason, *Steele & Hodgdon 2773* (STEELE); WASHINGTON CO., Pembroke, July 6, 1909, *Fernald & Wiegand* (GH); HANCOCK CO., Mt. Desert Island, July 18, 1896, *Rand* (NEBC); LINCOLN CO., Boothbay Harbor, *Hodgdon 12199* (NHA); South Bristol, *Hodgdon 12174* (NHA); YORK CO., Kennebunkport, *Steele & Hodgdon 3701* (STEELE); York, *Steele & Hodgdon 3744* (STEELE). NEW HAMPSHIRE: COÖS CO., Northumberland, *Fernald & Pease 15832* (NEBC); Dummer, *Fernald & Pease 15792* (NEBC); CARROLL CO., Sandwich, *Steele 3932* (STEELE); Madison, *Steele 3543* (STEELE); GRAFTON CO., Bath, *Fernald 15668* (NEBC); Franconia, *Hodgdon & Steele 11375* (NHA, STEELE); Rumney, *Hodgdon & Steele 11271* (NHA, STEELE); STRAFFORD CO., New Durham, *Hodgdon 9426* (NHA); Milton, *Hodgdon & Steele 11270* (NHA); ROCKINGHAM CO., Seabrook, *Hodgdon & Steele 11261* (NHA); HILLSBORO CO., Sharon, *Hodgdon 7216* (NHA). VERMONT: ESSEX CO., Granby, *Pease 26804* (NEBC); WINDHAM CO., Saxtons River, *Steele 3548* (STEELE); BENNINGTON CO., Woodford, June 29, 1939, *Knowlton* (NEBC). MASSACHUSETTS: BERKSHIRE CO., Pittsfield, July 14, 1919, *Hoffmann* (NEBC). CONNECTICUT: TOLLAND CO., Willington, *Weatherby 5332* (NEBC).

13. *Rubus allegheniensis* Porter. PRIMOCANE and FLORICANES erect to arching 1-2 m high, sometimes low-doming in late summer; ARMATURE of broad-based stout or occasionally thin prickles 2-7 mm long, 1-20 per dm.; PRIMOCANES glabrous or pubescent, mostly glandular particularly on upper parts and early in the season; FLORICANES usually glabrous and glandless; DIAMETER OF PRIMOCANE 4-8 (3-9) mm; PRIMOCANE-LEAFLETS 5, membranaceous ovate, ratio of width to length 0.6-0.75, acuminate, the terminal leaflets cordate to subcordate, the lateral leaflets rounded to subcordate at base, 8-15 mm long, glabrous to pubescent above, *velvety beneath*, central petiolules 2-6 cm long and longest laterals 1.5-5 m long; DIMENSIONS OF COMPOUND LEAF 12×12-23×23 cm; INFLORESCENCE when best developed and most typical forming cylindric racemes 8-20 cm long but often reduced to short racemes or corymbs to 3 cm long, flowers 9-22 in number but at times reduced to as few as 3 in the shorter clusters, axis of inflorescence pubescent and with *abundant glands*, with or without prickles; pedicels divergent to ascending 1.5-5 cm long, sometimes with weak scattered prickles; early flowering; FRUIT elongate to thimble-shaped or less often globular, of good quality; HABITAT, roadsides, old fields and cut over woods, RANGE, throughout New England at low elevations, common.

In spite of considerable variation, this is one of the most distinctive and earliest known species of blackberry. It is the common high blackberry, when well developed, producing long cylindrical racemes of good fruit. It is widespread, occurring throughout New England in fields and roadsides and quickly invading new lumbered areas. Chromosome counts indicate that it is one of the few diploid species. In good sites the globular, or more commonly thimble-shaped, fruits occur in abundance and are easy to pick.

This species and some of the Arguti occasionally have flowering primocanes, forming inflorescences that would be difficult to classify, unless their true nature is appreciated. An inflorescence with each single flower subtended by a leaf belongs in this category. Primocanes are fresh-green with buds at the end; floricanes are red or purple often with dead ends.

Although *R. allegheniensis* is normally arching and 4 to 6′ tall, stunted specimens only 1′ or 2′ high are frequent. These might be mistaken for another species, but the glandular floral axis and the soft pubescence on the underneath side of the leaves give clues as to the true nature of the plant. Colonies of this species have been found in which some of the outer plants dome and reach the ground. This may represent an extreme state of the plant modified by environmental factors or it may represent introgression with another species.

Rubus allegheniensis, on occasion, hybridizes with most other species. These hybrids are infrequent to rare, the most frequent being a cross with *R. setosus* which gives rise to various forms intermediate between the two parents, several of which have been designated as species.

REPRESENTATIVE SPECIMENS: This species is well enough understood and clearly enough marked to require a minimum of specimen citations. MAINE: PENOBSCOT CO., Milford, *Fernald 13867* (NEBC); PISCATAQUIS CO., Dover, September 1, 1896, *Fernald* (NEBC); SOMERSET CO., Fairfield, *Fernald & Long 13862* (NEBC); WASHINGTON CO., Lubec, *Hodgdon & Pike 7223* (NHA); HANCOCK CO., Dedham, *Fernald & Long 13861* (NEBC); KNOX CO., Isle au Haut, September 3, 1918, *Kidder* (NEBC); LINCOLN CO., Southport, August 2, 1894, *Fernald* (NEBC); ANDROSCOGGIN CO., Auburn, August 29, 1932, *Bean*

(NEBC); YORK CO., Wells, *Fernald & Long 13860* (NEBC). NEW HAMPSHIRE: COÖS CO., Dummer, *Fernald & Pease 15793* (NEBC); CARROLL CO., Conway, *Hodgdon & Steele, 11277* (NHA); GRAFTON CO., Woodstock, *Fernald 11752* (NEBC); STRAFFORD CO., Durham, *Hodgdon 3031* (NEBC); MERRIMACK CO., Hooksett, August 24, 1925, *Batchelder* (NEBC); SULLIVAN CO., Plainfield, August 9, 1962, *Cowden, Eaton, Hodgdon, Poole & Wilson* (NHA); ROCKINGHAM CO., Rye, *Pease 16937* (NEBC); CHESHIRE CO., Hinsdale, August 23, 1919, *Batchelder* (NEBC). VERMONT: ESSEX CO., Concord, *Pease 33722* (NEBC); ORLEANS CO., Newport, June 7, 1913, *Knowlton* (NEBC); CHITTENDEN CO., Hinesburg, July 17, 1940, *Knowlton* (NEBC); WINDSOR CO., Hartford, June 12, 1920, *Eaton & St. John* (NEBC); RUTLAND CO., Wallingford, June 21, 1909, *Kent* (NEBC); WINDHAM CO., Vernon, June 19, 1925, *Churchill & Knowlton* (NEBC). MASSACHUSETTS: ESSEX CO., Manchester, June 7, 1913, *Hubbard* (NEBC); MIDDLESEX CO., Concord, June 20, 1958, *Eaton* (NEBC); PLYMOUTH CO., Marshfield, June 26, 1926, *Knowlton* (NEBC); BARNSTABLE CO., Falmouth, August 9, 1927, *Fernald* (NEBC); DUKES CO., Marthas Vineyard, September 23, 1913, Bicknell (NEBC); WORCESTER CO., Douglas, *Fernald 15226* (NEBC); FRANKLIN CO., Colerain, June 18, 1921, *Churchill, Knowlton & Schweinfurth* (NEBC); HAMPSHIRE CO., Ware, September 2, 1916, *Forbes* (NEBC); BERKSHIRE CO., Sheffield, August 27, 1902, *Hoffmann* (NEBC). RHODE ISLAND: PROVIDENCE CO., East Providence, May 30, 1911, *Wiegand* (NEBC); BRISTOL CO., Barrington, May 30, 1911, *Winslow* (NEBC). CONNECTICUT: WINDHAM CO., Thompson, *Weatherby 5034* (NEBC); NEW LONDON CO., Franklin, July 5, 1912, *Woodward* (NEBC); TOLLAND CO., Bolton, *Weatherby 5318* (NEBC); HARTFORD CO., Hartland, *Weatherby 4343* (NEBC); MIDDLESEX CO., Cornwall, *Weatherby 4302* (NEBC); NEW HAVEN CO., Waterbury, *Blewitt 1314* (NEBC); LITCHFIELD CO., Norfolk, June 10, 1919, *Evans* (NEBC); FAIRFIELD CO., Danbury, July 19, 1912, *Harger* (NEBC).

14. *Rubus argutus* Link. PRIMOCANE and FLORICANE erect or high-arching (occasionally low-arching) 0.9-1.8 m high; ARMATURE of thin to stout prickles, 4-6 mm long, 10-30 per dm; DIAMETER OF CANE 3-5 (2-7) mm; PRIMOCANE-LEAFLETS 5, membranaceous, *lanceolate, narrow, the ratio of width to length* 0.4-0.45, acuminate at apex, 8-11 cm long, finely pilose to glabrous above, sparsely pilose to velvety beneath, *rounded to cuneate at base, the central base cuneate or subcuneate, the lateral rounded;* DIMENSIONS OF COMPOUND LEAF 13×13-17×17 cm; INFLORESCENCE a short diffuse raceme (corymb) 3-7 cm long and 3-5 cm across, the flowers 5-10 (4-12) in number, the axis and pedicels often with prickles, *glands* absent; medium-to late-flowering; HABITAT, thickets, edges of woods and bog-margins; RANGE, central and southern Massachusetts and southward at low elevations, uncommon.

The three species; *R. argutus, R. frondosus* and *R. pensilvanicus* are often classed as Arguti. *Rubus argutus* ap-

pears to be a distinctive blackberry, although of limited range. The leaflets are narrow, less than one half as broad as long, and the base of the central one is wedge-shaped. In other related species, the bases are rounded, or, more usually heart-shaped.

The species appears to be uncommon in New England but more frequent southward. There a number of collections from Virginia. In Massachusetts the northernmost station is south of Boston, and most of the other stations are on Cape Cod. It appears to be commonest at or near the coast and absent from upland or mountainous regions. No doubt with the development of the coast much suitable environment for it was destroyed and it may have been more common in the past.

REPRESENTATIVE SPECIMENS: MASSACHUSETTS: NORFOLK CO., Stoughton, *Blake 12127* (GH, Type of *R. Blakei* Bailey); BRISTOL CO., New Bedford, June 9, 1910, *Hervey* (NEBC); BARNSTABLE CO., Harwich, *Fernald & Long 16924* (GH, type of *R. paludivagus* Fernald); Bourne, *Fernald & Clark 16898* (NEBC); Barnstable, *St. John & Hubbard 11726* (NEBC); Falmouth, August 9, 1927, *Fernald 608* (NEBC); Brewster, *Steele & Hodgdon 3915* (NHA, STEELE). CONNECTICUT: NEW LONDON CO., Franklin, July 8, 1915, *Woodward* (NEBC).

15. *Rubus frondosus* Bigel. PRIMOCANE and FLORICANE erect to arching or even doming to 0.9-1.2 m high; ARMATURE of *thin to stout straight prickles 4-6 mm long, 4-60 in number* per dm; DIAMETER OF CANE 4-6 (3-7) mm; PRIMOCANE LEAFLETS 5, *subchartaceous to chartaceous* (occasionally membranaceous), ovate to obovate-rhombic, *leaflets often short and broad, ratio of width to length 0.6-0.8 (0.55)*, acuminate, 6-12 cm long, subglabrous to glabrous above, velvety below, terminal leaflet cordate to subcordate or rounded at base, lateral leaflets with bases rounded to subcuneate; petiolules of central leaflet from 1.2-3 (4.5) cm long, of middle lateral leaflets 0.1-1 (2.3) cm long; DIMENSIONS OF COMPOUND LEAF 11×11-19×19 cm; INFLORESCENCE a compact raceme (corymb) 4-9 cm long by 2-4 cm broad, flowers 3-10 (2-12) in number, axis pilose with few to 0 prickles, *leafy bracts 1-7*, sometimes lacking, *often conspicuous;* FRUIT globular to subglobular, large, juicy and often of exceptional quality; HABITAT, thickets, old fields and roadsides; RANGE, coast of Maine, southern New Hampshire and southern Vermont southward, common at low elevations.

This species is essentially southern in distribution, reaching its northern limit along the coast of Maine, and is more

distinctive in the southern part of its range where it is as common as *R. allegheniensis* and occupies similar environments. It often has good fruits and presumably was the source of some cultivated varieties.

It is closest in appearance to *Rubus pensilvanicus* and no doubt frequently intergrades with it. There is a difference in the texture of the leaves, those of *R. frondosus* being darker and subchartaceous, which gives the plant a distinctive appearance even at a distance. The prickles tend to be stouter and more numerous than those of *R. pensilvanicus* and the fruit is of better quality.

The primocanes frequently have lateral branches which elongate and may crawl over bushes or reach the ground, thus giving the plant a doming appearance. We include the state described as *R. multispinus* in our concept of *R. frondosus*. Because there is so much variation in the degree of doming in *R. frondosus* itself it would not seem to be a reliable character on which to separate two species. In some instances the doming habit is caused no doubt by introgression with some of the trailing species.

Although there seems to be a tendency in *Rubus frondosus* to have pronounced leafy bracts in the inflorescence this is by no means a constant or reliable character; often the inflorescences in perfectly good material are no more leafy than *R. pensilvanicus*.

REPRESENTATIVE SPECIMENS: MAINE: KNOX CO., Matinicus, July 9, 1920, *C. A. E. Long* (NEBC); Isle Au Haut, August 2, 1919, *Kidder* (NEBC); LINCOLN CO., Boothbay Harbor, August 19, 1955, *Steele & Hodgdon 2154* (STEELE); Southport, *Hodgdon 7230* (NHA). NEW HAMPSHIRE: STRAFFORD CO., Durham, *Hodgdon & Steele 12188* (NHA); HILLSBORO CO., Hollis, *Steele & Hodgdon 4009* (STEELE). MASSACHUSETTS: SUFFOLK CO., Boston, June 25, 1908, *Rich* (NEBC); BARNSTABLE CO., Harwich, *Fernald 16895* (NEBC); Harwich, *Fernald 16917* (NEBC); Harwich, *Steele & Hodgdon 3925* (NHA, STEELE); Chatham, *Fernald & Long 18578* (NEBC); Brewster, *Hodgdon & Steele 14845* (NHA); DUKES CO., Chilmark, *Steele 4011* (STEELE); NANTUCKET CO., Nantucket, *Bicknell 11932* (NEBC); WORCESTER CO., Sterling, *Hodgdon & Steele 14846* (NHA); Berlin, *Hodgdon & Steele 14847* (NHA); HAMPDEN CO., Springfield, June 30, 1914, *Andrews* (NEBC). RHODE ISLAND: WASHINGTON CO., Charlestown, *Hodgdon & Steele 14848* (NHA). CONNECTICUT: NEW LONDON CO.,

Mystic, *Hodgdon & Steele 14849* (NHA); Salem, *Steele & Hodgdon 3906* (STEELE); TOLLAND CO., Stafford Springs, *Hodgdon & Steele 14850* (NHA); HARTFORD CO., Hartford, *Wright* (NEBC); Berlin, *Steele & Hodgdon 3931* (NHA, Steele); Southington, *Steele & Hodgdon 3910* (STEELE, NHA); MIDDLESEX CO., Haddam, *Hodgdon & Steele 148501* (NHA); NEW HAVEN CO., Orford, *Harger 5552* (NEBC).

16. *Rubus pensilvanicus* Poir. PRIMOCANE and FLORICANE erect to somewhat arching 0.6-2.2 m high; ARMATURE of *thin to medium prickles 2-4 (5) mm long, tending to be rather few, 0-20 (27)* per dm; DIAMETER OF CANE 4-9 (2-10) mm; PRIMOCANE LEAFLETS 5, *membranaceous to subchartaceous*, ovate, *ratio of width to length 0.55-0.75 (0.5)*, apex acuminate, 8-13(16) cm long; glabrous or nearly so above, moderately pilose to velvety beneath, leaf base cordate or subcordate to rounded; petiolules of central leaflet 2-5(6) cm long, of medium lateral leaflets 0-2.5(4.5) cm, the larger lateral petiolules frequently more than 1 cm long; DIMENSIONS OF COMPOUND LEAF 11×11-22×22(30×30), often large; INFLORESCENCE varying, from long to short and somewhat compact racemes (corymbs), flowers 7-12(4-20) in number, axis pilose with occasional prickles and no glands, *leafy bracts 1-2(0-6)*; FRUIT fair to good, not often produced in abundance; HABITAT, thickets, roadsides, swamps and woods; RANGE, throughout New England, at low elevations, scarcer northward, a scattered and not very common species.

Although this species has a wide distribution extending from northern New Hampshire southward throughout New England, it has certain puzzling aspects and is not always clearly defined. A plant from the northernmost known New Hampshire station, in Franconia Notch, resembles *R. canadensis* except for a thin pubescence on the underneath side of the leaves. Specimens from the few scattered stations immediately southward also resemble *R. canadensis* or a hybrid of *R. alleghenicnsis* and *R. canadensis*. Thus there is a question about the specific identy of the northern specimens, which might account for some of the diversity.

In southern New Hampshire the plant becomes more common and better marked. The prickles instead of being infrequent and minute as in *R. canadensis* are of medium-size and more abundant. In southern New England the prickles tend toward those of *R. frondosus*.

Folders in herbaria contain some plants with slightly glandular inflorescences, which must represent some influence of *R. alleghenicnsis*. Chromosome counts indicate

that this plant may contain both triploid and tetraploid elements, which might account for some of the diversity.

This is another of the species of *Rubus* in which flowering primocanes are not uncommon and represent a possible source of confusion.

REPRESENTATIVE SPECIMENS: MAINE: PENOBSCOT CO., Milford, *Fernald 13866* (NEBC); OXFORD CO., Bethel, *Pease 37595* (NEBC); LINCOLN CO., Monhegan Island, September 2, 1921, *Churchill* (NEBC); Boothbay Harbor, *Hodgdon 2719* (NHA); KENNEBEC CO., Clinton, July 17, 1915, *Bean* (NEBC); ANDROSCOGGIN CO., Auburn, August 17, 1916, *Bean* (NEBC); YORK CO., Kennebunkport (Parson Beach), July 8, 1905, *Blanchard* (NEBC); Kennebunkport, *Hodgdon & Steele 12485* (NHA). NEW HAMPSHIRE: COÖS CO., Dummer, *Harris 26588* (NEBC); Jefferson, *Pease 16899* (NEBC); Northumberland, *Fernald & Pease 15675* (NEBC); Colebrook, *Fernald & Pease 15794* (NEBC); CARROLL CO., Tuftonboro, *Hodgdon & Steele 12187* (NHA); Sandwich, *Steele 4001* (STEELE); GRAFTON CO., Haverhill, *Fernald 15769* (NEBC); Bath, *Fernald 15593* (NEBC); Thornton, *Hodgdon, Steele, & Lincoln 11265* (NHA, STEELE); Rumney, *Hodgdon & Steele 11297* (NHA, STEELE); STRAFFORD CO., New Durham, *Hodgdon & Steele 12259* (NHA); Durham, *Hodgdon & Steele 11298* (NHA); MERRIMACK CO., Hooksett, August 16, 1925, *Batchelder* (NEBC); Newbury, *Hodgdon 11377* (NHA); SULLIVAN CO., Plainfield, August 9, 1962, *Cowden, Eaton, Hodgdon, Poole & Wilson* (NHA); HILLSBORO CO., Peterboro, *Batchelder 693* (NEBC); CHESHIRE CO., Nelson, *Batchelder 2812* (NEBC). VERMONT: RUTLAND CO., Wallingford, September 1, 1912, *Kent* (NEBC); BENNINGTON CO., Searsburg, June 20, 1925, *Carpenter, Churchill & Knowlton,* (NEBC). MASSACHUSETTS: MIDDLESEX CO., Arlington, August 15, 1885, *Batchelder* (NEBC); Concord, July 13, 1935, *Eaton* (NEBC); BRISTOL CO., New Bedford, June 15, 1900, *Hervey* (NEBC); BARNSTABLE CO., Sandwich, *Fernald & Long 18575* (NEBC); Falmouth, August 9, 1927, *Fernald* (NEBC); WORCESTER CO., Harvard, August 6, 1916, *Forbes* (NEBC); FRANKLIN CO., Shelburne Falls, July 4, 1921, *Churchill* (NEBC); BERKSHIRE CO., New Marlboro, July 9, 1912, *Hoffmann* (NEBC). CONNECTICUT: WINDHAM CO., Plainfield, *Harger 6419* (NEBC); NEW LONDON CO., Groton, *Hodgdon & Steele 14852* (NHA); HARTFORD CO., New Canaan, *Steele 3934* (STEELE); LITCHFIELD CO., Colebrook, *Weatherby 2680* (NEBC); FAIRFIELD CO., Stratford, *Eames 2120* (NEBC).

REJECTED SPECIES

The following list of rejected New England species provides a suggested interpretation of each. No attempt is made to deal here with subspecific taxa. The generic name

Rubus is understood and the name of Bailey is also considered to be superfluous as the author of most of the names.

abactus = *pensilvanicus*
abbrevians Blanch. = *setosus* × *allegheniensis*
aculiferus Fern. = *setosus* × *allegheniensis*
adjacens Fern. = *hispidus* × *setosus*
alius = *arenicola*
alter = *hispidus* × *setosus*
alumnus = *allegheniensis* × *pensilvanicus*
amicalis Blanch. = *elegantulus*
amnicola Blanch. = *pensilvanicus*
Andrewsianus Blanch. = *pensilvanicus*
apparatus = *vermontanus*
aptatus = *recurvicaulis*
arcuans Fern. & St. John = *recurvicaulis* × *setosus*
arundelanus Blanch. = *recurvicaulis*
ascendens Blanch. = *semisetosus*
auroralis = *allegheniensis*
avipes = *pensilvanicus*
Baileyanus Britt. (type inadequate) = *Enslenii*
barbarus = *pensilvanicus*
bellobatus = *frondosus*
Bicknellii = *setosus* × *recurvicaulis*
biformispinus Blanch. = *hispidus* × *allegheniensis*
Bigelovianus = *semisetosus*
Blakei = *argutus*
Blanchardianus = *hispidus* × *setosus*
Boottianus = *setosus*
Brainerdii Rydb. = *arenicola*
brevipedalis = *recurvicaulis*
coloniatus = *recurvicaulis*
conanicutensis = *pensilvanicus*
cubitans Blanch. = *hispidus*
curtipes = *arenicola*
Deaneanus = *vermontanus*
eflagellaris = hybrid involving one of the Flagellares
electus = *hispidus* × *allegheniensis*
facetus = *pensilvanicus*
felix = *flagellaris*
Fernaldianus = *allegheniensis*
frondisentis Blanch. = *setosus*
geophilus = *flagellaris*
glandicaulis Blanch. = *setosus* × *allegheniensis*
gnarus = identity unknown
Gravesii (Fern.) Bailey = *allegheniensis*
Groutianus Blanch. = *setosus* × *vermontanus*
harmonicus = *hispidus* × *setosus*
heterogeneous = *frondosus*
heterophyllus Willd. = identity unknown
hispidoides = *semisetosus*
honorus = *pensilvanicus*
insons = *pensilvanicus*
insulanus = *frondosus*
invisus (Bailey) Britt. = not in New England according to Bailey
jacens Blanch. = *hispidus* × *setosus*
jactus = *hispidus* × *allegheniensis*
Janssonii = *arenicola*
Jeckylanus Blanch. = *recurvicaulis*
jugosus = *argutus*
junceus = *vermontanus*
junior = *setosus*
Kennedyanus Fern. = *elegantulus*
laevior (Bailey) Fern. = *his-*

pidus × *allegheniensis*
latens = hybrid involving *allegheniensis*
Lawrencei = *setosus*
licitus = *allegheniensis* × *pensilvanicus*
longissimus = *allegheniensis*
mainensis = *hispidus* × *flagellaris*
maniseesinsis = *flagellaris*
Millspaughii Britt. = *canadensis*
miscix = *vermontanus* × *pensilvanicus*
montpelierensis Blanch. = *setosus* × *allegheniensis*
multiformis Blanch. = *elegantulus*
multilicius = *vermontanus* × *elegantulus*
multispinus Blanch. = *frondosus*
nigricans Rydb. = *setosus*
nigrobaccus = *allegheniensis*
notatus = *setosus*
novanglicus = identity unknown
obsessus = *arenicola*
orarius Blanch. = *pensilvanicus*
ortivus = *semisetosus*
ostryifolius Rydb. = *pensilvanicus*
paludivigus Fern. = *argutus*
Parlinii = *setosus* × *vermontanus*
paulus = *allegheniensis* × *pensilvanicus*
pauper = *arenicola*
peculiaris = *vermontanus* × *pensilvanicus*
pergratus Blanch. = *pensilvanicus*
perinvisus = *semisetosus*
permixtus Blanch. = *hispidus* × *allegheniensis*
perpauper = *arenicola*
pervarius = *hispidus*
philadelphicus Blanch. = *pensilvanicus*
plicatifolius Blanch. = *recurvicaulis*
positivus = *recurvicaulis*
procumbens Muhl. = *flagellaris*
prosper Bailey = *arenicola*
pudens = *hispidus* × *setosus*
pugnax = *allegheniensis*
Randii Rydb. = *canadensis* (depauperate)
ravus = *vermontanus* × *allegheniensis*
recurvans Blanch. = *frondosus*
rhodinsulanus = *recurvicaulis*
rixosus = *hispidus* × *setosus*
roribaccus (Bailey) Rydb. = doubtfully present in New England, an escape from cultivation in the North
Rosa = *allegheniensis* × *pensilvanicus*
Rossbergianus Blanch. = *frondosus*
saltuensis = *allegheniensis*
Sanfordii = *hispidus* × *allegheniensis*
sativus Brain. = *allegheniensis*
scambens = *Jaysmithii* (specimen called R. *scambens* from New England is *flagellaris*
sceleratus Brain. = *setosus* × *allegheniensis*
semierectus Blanch. = *recurvicaulis*
sempervirens Bigel. = *Enslenii*
severus Brain. = *recurvicaulis* × *vermontanus*
significans = *setosus*
singulus = *vermontanus*
spiculosis Fern. = *hispidus*
tardatus Blanch. = extreme of *vermontanus*
tetricus = *Jaysmithii*
tholiformis Fern. = *hispidus* × *setosus*

trifrons Blanch. = *hispidus* × *setosus*
udus = *setosus*
usus = *recurvicaulis*
univocus = *setosus* × *vermontanus*
vigoratus = *hispidus* × *setosus*
viridifrons = *hispidus* × *vermontanus*

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THE IDENTITY OF SISYMBRIUM PAUCIFLORUM (CRUCIFERAE). — In the Flora of North America, Torrey and Gray (1838) published as *Sisymbrium pauciflorum*, a name from Nuttall's manuscript that has since been largely ignored. Robinson (1895) put it succinctly when he stated, "S. PAUCIFLORUM, Nutt. . . . . has always been obscure, and appears to have been founded upon immature specimens of *Arabis canescens*." Payson (1922) in his treatment of *Sisymbrium* failed to mention *S. pauciflorum*, even though he attempted to account for the North American species of the genus, north of Mexico. Also, Floras covering the Rocky Mountain Region, where the type material of *S. pauciflorum* was collected by Nuttall, have not taken the name into account.

My own earlier attempt to deal with the name (Rollins, 1941) was prompted by Robinson's suggestion that the plant Nuttall described belonged to the genus *Arabis*. On the basis of the original description and some notes about the type provided by a colleague, it was clear to me then that the type specimen was indeed an *Arabis*. Since the specific epithet *pauciflora* was preoccupied by *Arabis pauciflora* (Grimm) Garcke, the exact positioning of the Nuttall name in *Arabis* as to species had no particular nomenclatural consequences and the most abundant species of *Arabis* to which the description and notes might apply was *A. holboellii*, var. *retrofracta*, this is where I listed *Sisymbrium pauciflorum* as a synonym.

A few months ago, I was privileged to examine the type of *Sisymbrium pauciflorum* in the British Museum. The identity is unmistakable. It is *Arabis fendleri* var. *spati-*

folia (Rydberg) Rollins. This is rather unexpected because the taxon is not commonly found in Wyoming on Nuttall's collecting route. However, the original description is accurate and now that the identity is known, there is no difficulty in following it.

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BOTANICAL NOTES FROM THE PRINGLE HERBARIUM I.

In the course of compiling data at the Pringle Herbarium of the University of Vermont for my forthcoming book on the Flora of New England, a number of items have come to my attention which seem worth publication. Most of these items consist of species new to the State of Vermont, meaning that they are not listed in the latest edition of the Flora of Vermont by E. J. Dole (1937). A new edition of that Flora is in preparation by this author. In some cases, the occurrence of these taxa may have been published elsewhere, but not to my knowledge. Even so, it is desirable for them to be listed together under the heading of Vermont. The voucher specimens unless otherwise indicated are deposited in the Pringle Herbarium.

1. JUNIPERUS COMMUNIS L. var. COMMUNIS. Vermont: Dorset Hollow, 6 Aug. 1965, *Alfred H. Gilbert*. Mr. Gilbert writes, 6 Aug. 1965: "This is distinctly an upright form."

2. BROMUS COMMUTATUS Schrader. Occasional, several localities; the earliest coll. C. G. Pringle as early as 1880, without definite locality. This species has been much confused with *B. secalinus* L. from which it differs in having the margins of the lemmas concealing the rachis, not inrolled as in *B. secalinus*.

3. BROMUS COMMUTATUS Schrader forma **perglaber** forma nova. *B. commutatus* f. *commutatus* has the sheaths, even the upper ones, with abundant long spreading hairs. In some specimens of this species, all the sheaths are glabrous in striking contrast to the typical form. Therefore, the specimens with glabrous sheaths deserve recognition by name. I designate them as forma *perglaber* forma nova. Vaginis glabris. Type: Maine, North Berwick, July 1893, *J. C. Parlin* (NEBC). Among other specimens of this new form are: New Hampshire, Dover, 18 June 1937, *A. R. Hodgdon* (NEBC); Mass., Swampscott, 13 June 1891, *J. R. Churchill* (NEBC); Dedham, 27 June 1897, *F. F. Forbes* (NEBC). An example of an intermediate is: Connecticut: Fairfield, 12 June 1895, *E. H. Eames* (NEBC), in which the lowest sheaths are slightly hairy.

4. ERAGROSTIS PILOSA (L.) Beauv. Vermont: Woodstock, *Miss E. Billings*, 1905. This species is easily confused with *E. pectinacea* (Mx.) Nees. In the specimen cited, the spikelets are not over 1 mm wide and the branches of the panicle are thread-like and flowerless near the main axis. The Manual of Grasses, ed. 2, by Agnes Chase, figure 201, indicates by a dot that it has been found in Vermont, but this specimen by Miss Billings is the only one I have seen from Vermont.

5. AIRA CARYOPHYLLEA L. A considerable colony in a driveway in front of a tent-site in the State Camping Grounds in Stillwater, Groton, near the shore of Lake Groton, 27 June 1963, *Seymour 20, 650*.

6. ELEUSINE INDICA (L.) Gaertner. Hartford Center, 9

Sept. 1938, *L. A. Charette 858*. This species appears to be spreading rapidly but has not been reported previously from Vermont.

7. PHLEUM PRATENSE L. var. NODOSUM (L.) Hudson. Burlington and Middlebury. This variety is doubtless abundant, but it has not previously been reported from Vermont.

8. LEPTOLOMA COGNATUM (Schultes) Chase. Burlington, 10 Aug. 1938, *E. J. Dole 642*. Misidentified as *Eragrostis spectabilis* (Pursh) Steudel var. *sparsihirsuta* Farw. which it strongly resembles in general habit. This new station for an uncommon grass is noteworthy because it is far from the other known stations in Vermont, all of which are in the valley of the Connecticut River.

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A NEW METHOD FOR MAINTAINING THE CONES OF ABIES AND CEDRUS INTACT FOR STUDY AND STORAGE

In the cones of *Abies* and *Cedrus*, both the scales and bracts together become deciduous at maturity. Unless some means of preservation is accomplished, these cones disintegrate leaving a somewhat bare, spike-like persistent axis. In the past those wishing to retain cones of *Abies* or *Cedrus* in good condition for herbaria, display, or as teaching aids were forced to resort to binding each cone with wire or string. This method is often unsuccessful and results in unattractive specimens which must be handled with much care.

We have found that the clear plastic described by Archer (1950) and now used by many herbaria for mounting specimens can be used for treating cones of *Abies* and *Cedrus* (Figure 1). The plastic is prepared according to Archer's formula as modified by Rollins (1955), and placed in a

Plate 1337. Cones which have been treated with clear plastic; twelve months after treatment. Left to right: *Abies magnifica, Abies concolor, Cedrus atlantica.*

small, easy to handle, glass container (a 16-ounce size works well).

Specimens to be treated should have ¼- to ½-inch of the stem attached. After tying a 6-inch piece of string to the stem at the base of the cone, hold the cone by the base over a disposable tray and slowly pour plastic over it. Rotate the cone to insure a thin, even coating. It is imporant that the entire cone be coated and that no holes are left. When the cone is covered, it should be hung by the string to dry. As it dries excess plastic should be trimmed from the tip of the cone.

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SOME PLANTS NEW TO TENNESSEE[1]

Plant collections made during the summer of 1965[2] included representatives of six genera and fifteen species and varieties which are, to the best of our knowledge, previously unreported from Tennessee. Specimens have been deposited in the State Herbarium at The University of Tennessee.

Nomenclature and systematic arrangement of the list is according to Fernald (1950), and Hitchcock (1951). The annotations include the county in which collected, the collection number or numbers, the general range of the taxon, and comments on the present collection if it represents an extension in range.

POA PALUSTRIS L. Carter County. *34665*. The general range is from Newfoundland to Alaska, south to Virginia, western North Carolina, West Virginia, Missouri, Nebraska, New Mexico, Colorado and California. Our collection extends its range to include Tennessee.

ERAGROSTIS INTERMEDIA Hitchc. Shelby County. *33510*. This species is reported from Georgia to Arizona and New Mexico, north to Missouri and Kansas. The collection in west Tennessee appears to represent a northern extension of its known range.

TRIPLASIS PURPUREA (Walt.) Chapm. Shelby County. *34465, 33525*. Ontario and Maine to Minnesota and Nebraska, south to Florida and Texas; Colorado.

SPOROBOLUS CRYPTANDRUS (Torr.) A. Gray. Shelby, Lake Counties. *34771, 34467, 33757, 33532*. Maine to Washington, south to North Carolina, West Virginia, Indiana, Illinois, Louisiana, Texas, southern California, and Mexico.

MUHLENBERGIA SOBOLIFERA var. SETIGERA Scribn. Sevier County. *34291*. This variety has been reported only from Arkansas and Texas. Our collection is an eastward extension in range.

CHLORIS VERTICILLATA Nutt. Hardin County. *33603*. Nebraska to Texas, and southern California; Maine and Massachusetts; Ohio, Indiana, and North Carolina to Florida; Louisiana and Missouri. The collection from near the Tennessee River in Tennessee was

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[1]Contributions from the Botanical Laboratory, The University of Tennessee, N. S. 256.

[2]Field collecting was supported primarily by a contract between the Tennessee Game and Fish Commission and The University of Tennessee, and was part of a continuing study for the preparation of a manual of grasses, their identification, habitat, distribution, and use by game species in Tennessee.

from an area sown to cultivated grass. This is a southward extension in its recorded range.

LEPTOCHLOA UNINERVIA (Presl) Hitchc. and Chase. Shelby County. *34062, 33567, 33505, 33649.* North Carolina; Mississippi to Colorado and California, south to Argentina; introduced in Maine, Massachusetts, and New Jersey. Our collections appear indigenous and thus represent a northward extension in its known natural range from the Coastal Plain.

ERIOCHLOA GRACILIS (Fourn.) Hitchc. Lake County. *33672.* Oklahoma to southern California, south to Mexico. This collection is from a county that is 80-90% under cultivation, and it very probably represents an introduction.

ERIOCHLOA CONTRACTA Hitchc. Lake County. *33671.* Nebraska to Colorado, Louisiana and Arizona; adventive in Missouri and Virginia. This species, as with the preceding one, is primarily a western grass, and its occurrence in Tennessee represents an eastward extension of range.

PANICUM SPHAEROCARPON var. INFLATUM (Scribn. & Sm.) Hitchc. Shelby, Fayette, and Dyer Counties. *33511, 33546, 33518, 33696, 33515.* Coastal Plain, Delaware to Florida and Texas, north to Oklahoma and Missouri.

JUNCUS VALIDUS Coville. Hardeman County. *34907.* Florida to Texas, north to Georgia, Missouri, and Oklahoma.

CYCLOLOMA ATRIPLICIFOLIUM (Spreng.) Coult. Shelby County. *33569, 34773.* Mississipi to Texas, Arizona, Manitoba, and Massachusetts.

AMARANTHUS TAMARISCINUS Nutt. Shelby County. *33521.* A plant of hybrid origin for which distribution information is not available.

AEGOPODIUM PODAGRARIA L. Cocke County. *34005.* Newfoundland to Michigan, south to Nova Scotia, New England and North Carolina. The specimen was collected at an abandoned homesite, where it may have been planted.

HETEROTHECA SUBAXILLARIS (Lam.) Britt. and Rusby. Shelby County. *34409.* Florida to Arizona and Mexico, north to Delaware, New Jersey, Illinois, Missouri, and Kansas.

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SPERGULA MORISONII IN AMERICA

In 1944, Fernald first reported the occurrence of *Spergula pentandra* L. (Caryophyllaceae) in America, from a collection made by O. H. Brown at the Cold Spring Cemetery, Cape May, New Jersey, on April 8, 1942. A description and illustration (based on European specimens at NY) of *S. pentandra* were included by Maguire (1952) in the New Britton and Brown Illustrated Flora.

In the spring of 1965, I collected a *Spergula* at Lakehurst, New Jersey. The plants had seeds with conspicuous wings, and were tentatively identified as *S. pentandra*. They belong, rather, to the closely related *S. morisonii* Boreau (1847), as determined by Dr. Arthur Cronquist of the New York Botanical Garden. *Spergula morisonii* is reported here for the first time in America.

Spergula morisonii differs from *S. pentandra* chiefly in the obtuse, slightly overlapping petals, and the brownish, striate wing of the seed. The petals of *S. pentandra* are acute, not overlapping, and the seed is surrounded by a striking, white wing. Examination of the NY specimens of both species indicates considerable blurring of these distinctions in European material. If, however, the two are considered distinct, the Lakehurst plants are certainly *S. morisonii*. The Brown specimen (GH) has immature seeds, but another collection, also at GH, from North Carolina *(H. E. Ahles 52617)* shows typical, mature seeds of *S. pentandra*.

Collection data for the Lakehurst plants are as follows: In ballast along railroad tracks at Lakehurst, Ocean County, New Jersey. G. L. Smith 2377. April 30, 1965 (NY).

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REVISED CHECK-LIST OF THE VASCULAR PLANTS OF MAINE[1]

This new up-to-date amplified and corrected check-list of the vascular flora of Maine is a welcome contribution. It is a pleasure to note that the volume is dedicated to Ralph C. Bean whose scholarly contributions to New England botany and particularly that of Maine are too numerous to summarize here. Indeed the preparation of the revised check-list is primarily the result of Mr. Bean's painstaking study of specimens and recording of records from Maine in the herbarium of the New England Botanical Club.

Many of the obvious deficiencies of the earlier check-list[2], which serves as an exact model for the present volume, have been corrected; the list is much more complete; introduced species appear now with an asterisk before the specific epithet and some of the arboreal species that were listed in the earlier volume such as *Ginkgo biloba* and *Sciadopitys verticillata* are thankfully omitted. In the years intervening since the first list, certainly most of the extant herbarium material must have been studied. We can happily be confident that this is not a rush job; it is a dependable list which will serve as a secure base for further collections. It is to be noted that the late Dr. Anne Perkins of South Berwick, Maine who was particularly dissatisfied with the earlier list because of the many omissions, sent to the pres-

[1]Ralph C. Bean, Richards, Charles D. and Hyland, Fay. Revised Check-list of the Vascular Plants of Maine. Josselyn Bot. Soc. Me. Bull. No. 8 71 pp. Orono, Me. July 1966.

[2]E. C. Ogden, Steinmetz, F. H. and Hyland, F. Check-list of the Vascular Plants of Maine. Josselyn Bot. Soc. Me. Bull. No. 8. 1948.

ent reviewer about the year 1949, a "partial list of York Co. plants omitted from check-list". There were twenty-six taxa excluding Carices so specified. Of these all except eight are reported from York Co. in the new list. It is quite possible that specimens of those missing from the present list may be found at Cornell University where Dr. Perkins deposited her collections.

In this reviewer's opinion one aspect of the present volume should provoke some discussion. Professor Fernald reviewed the earlier check-list at some length[3]. Much of the burden of Fernald's critique was directed to the problem of properly indicating for each species in a flora its correct native or introduced status. In fact he went so far (p. 8) as to suggest some criteria to indicate the degree of establishment of introduced species and relative abundance of native species. Admittedly this would be difficult to do but some such distinctions, if not too finely drawn, would greatly enhance the value of any floristic work. Most floras as well as Gray's Manual itself too often are misleading or else lacking in any sort of information about known relative abundance of the various taxa under consideration.

The Maine check-list still hasn't resolved this problem; in fact a certain degree of inconsistency seems to prevail. Quoting from the Foreword to the first edition which is reprinted in the revised edition, "Those plants growing on wool-waste, ballast, abandoned-gardens and other habitats where they may not yet be part of our flora but show indications of becoming so are indicated by minus (−) signs." A large number of both herbaceous and woody taxa were indicated as occurring in the appropriate counties by (−) signs in the earlier list but all or nearly all of the herbaceous taxa in the more recent list have been changed to (+) signifying that they now are "considered to be a part of our flora", whereas the woody taxa have been left essentially as they were in the earlier treatment except for the few that have been excluded. Fernald (loc. cit.) cited

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[3]Fernald, M. L. An abbreviated Flora of Maine. RHODORA **51**: 5-8, 1949

Deschampsia elongata, Chenopodium graveolens and *Collomia linearis* as species whose permanent status in the Maine flora might be questioned and therefore merit the (−) sign; yet in the revised list these still are indicated by the (+) sign as they were earlier. Presumably it has not been possible to demonstrate that these no longer occur in the wild.

It is hoped that a future edition would correct a few errors in the woody plants and add some indications of relative abundance. The authors are to be commended for leaving out *Ginkgo biloba* and *Sciadopitys verticillata* from the revised edition but what shall we say of *Abies concolor,* (about which there is no mention in Gray's Manual 8th edition) of *Juglans nigra, Magnolia acuminata, Liriodendron tulipifera* and *Gymnocladus dioica* (in Gray's Manual not stated to spread from cultivation in New England beyond their natural ranges) or of *Cladrastis lutea* ("spreads from cultivation north to Massachusetts")? In New Hampshire we have no evidence that these produce new individuals in nature and the same probably holds true in Maine. However Mr. Richard Eaton states that *Juglans nigra* spreads naturally in eastern Massachusetts and he has found it in thin woods (old pastures) in southern Vermont.

On the other hand it is quite evident that *Berberis vulgaris* and *Berberis Thunbergii* are part of the flora in some areas of Maine. The latter has become decidedly weedy in Bayville (part of Boothbay Harbor, Maine). In fact it has to be pulled up constantly from beneath a heavy growth of *Abies balsamea, Picea glauca* and *P. rubens* to prevent it from overrunning the woods and appears abundantly throughout this community at the head of Linekin Bay. On a recent visit to Monhegan Island, plants in varying stages of growth were observed along trails and in the woods at some distance from plantings. The capacity of *Syringa vulgaris* to persist for generations after the original planting and to spread by vegetative means over extensive areas must certainly cause it to be as much a part of the flora as are certain of the wool-waste species that reproduce only locally by seeds.

The reviewer may be pardoned for dwelling on the deficiencies. It is his ambition to do a similar check-list for New Hampshire in the near future and if he can succeed as well and produce as complete and accurate a list as this one is in most particulars he will be well pleased.

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Errata for RHODORA

p. 3 line 15 for altissiumum, read altissimum
p. 256 line 27 for Deyeuzia, read Deyeuxia

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